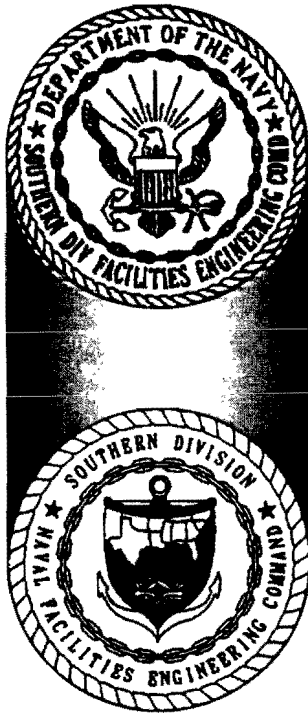


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CORRECTIVE MEASURES STUDY WORK PLAN RATIONALE FOR NO FURTHER ACTION
SOLID WASTE MANAGEMENT UNIT 47 (SWMU 47) ZONE C WITH TRANSMITTAL CNC
CHARLESTON SC
4/2/2001
NAVFAC SOUTHERN

CORRECTIVE MEASURES STUDY WORK PLAN

Rationale for No Further Action **Solid Waste Management Unit 47, Zone C**



***Charleston Naval Complex
North Charleston, South Carolina***

SUBMITTED TO
***U.S. Navy Southern Division
Naval Facilities Engineering Command***

PREPARED BY
CH2M-Jones

March 2001

*Revision 1
Contract N62467-99-C-0960*

CORRECTIVE MEASURES STUDY WORK PLAN

Rationale for No Further Action **Solid Waste Management Unit 47, Zone C**



***Charleston Naval Complex
North Charleston, South Carolina***

SUBMITTED TO
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Naval Facilities Engineering Command***

PREPARED BY
CH2M-Jones

March 2001

*Revision 1
Contract N62467-99-C-0960
158814.ZC.PR.04*

FAX TRANSMITTAL# of pages **2**

To M. MEHTA	From Rob Harrell
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NSN 7540-01-317-7368 5099-101 GENERAL SERVICES ADMINISTRATION

5090/11
Code 18713
02 APR 01

Mr. John Litton, P.E.
Director, Division of Hazardous and Infectious Waste Management
Bureau of Land and Waste Management
South Carolina Department of Health and Environmental Control
2600 Bull Street
Columbia, SC 29201

Subj: SUBMITTAL OF CORRECTIVE MEASURES STUDY WORK PLAN FOR SWMU
47, ZONE C

Dear Mr. Litton,

The purpose of this letter is to submit the Corrective Measures Study Work Plan (Revision 1) for SWMU 47, Zone C, located at the Charleston Naval Complex. The work plan is submitted to fulfill the requirements of condition IV.E.2 of the RCRA Part B permit issued to the Navy by the South Carolina Department of Health and Environmental Control and the U.S. Environmental Protection Agency (EPA).

This document and the proposed rationale for no further action were discussed by the Charleston Naval Complex BRAC Cleanup Team. CH2M Hill has distributed the document under separate cover letter. Appropriate certification is provided under that correspondence. We request that the Department and the EPA review this document and provide comments or approval whichever is appropriate.

If you should have any questions, please contact, Matthew Humphrey or myself at (843) 743-9985 and (843) 820-5551 respectively.

Sincerely,

ROBERT A. HARRELL, JR., P.E.
Environmental Engineer
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Copy to:
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March 30, 2001

John Litton, P.E.,
Director
Division of Hazardous and Infectious Wastes
South Carolina Department of Health and
Environmental Control
Bureau of Land and Waste Management
2600 Bull Street
Columbia, SC 29201

Re: Corrective Measures Study (CMS) Work Plan - Rationale for No Further Action for
SWMU 47, at the Charleston Naval Complex (CNC), Revision 1

Dear Mr. Litton:

Enclosed please find four copies of the CMS Work Plan – Rationale for No Further Action
for SWMU 47, at the CNC, Revision 1. This report has been prepared pursuant to
agreements by the CNC BRAC Cleanup Team for completing the RCRA Corrective Action
process.

Please contact me if you have any questions or comments.

Sincerely,

CH2M HILL

Dean Williamson, P.E.

xc: Tony Hunt/Navy, w/att
Rob Harrell/Navy, w/att
Mihir Mehta/SCDHEC
Gary Foster/CH2M HILL w/att

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Acronyms and Abbreviations

2	AOC	Area of Concern
3	BCT	BRAC Clean-Up Team
4	BEQ	benzo(a)pyrene equivalent
5	BRAC	Defense Base Realignment and Closure Act
6	CA	Corrective Action
7	CMS	Corrective Measures Study
8	CMS WP	Corrective Measures Study Work Plan
9	CNC	Charleston Naval Complex
10	COC	Chemical of Concern
11	DAF	dilution attenuation factor
12	DPT	Direct-Push Technology
13	EPA	U.S. Environmental Protection Agency
14	ft	foot
15	IM	Interim Measure
16	IM WP	Interim Measure Work Plan
17	µg/kg	microgram per kilogram
18	µg/L	microgram per liter
19	MCL	maximum contaminant level
20	mg/kg	milligram per kilogram
21	NAVBASE	Naval Base
22	NFA	No Further Action
23	OWS	oil-water separator
24	PAH	polynuclear aromatic hydrocarbon
25	PCB	polychlorinated biphenyl
26	RBC	risk-based concentration
27	RCRA	Resource Conservation and Recovery Act
28	RFA	RCRA Facility Assessment
29	RFI	RCRA Facility Investigation

1	SCDHEC	South Carolina Department of Health and Environmental Control
2	SSL	soil screening level
3	SVOC	semi-volatile organic compound
4	SWMU	Solid Waste Management Unit
5	UST	underground storage tank
6	VOC	volatile organic compound

SECTION 1.0

Introduction

1.0 Introduction

In 1993, Naval Base (NAVBASE) Charleston was added to the list of bases scheduled for closure as part of the Defense Base Realignment and Closure Act (BRAC), which regulates closure and transition of property to the community. The Charleston Naval Complex (CNC) was formed as a result of the dis-establishment of the Charleston Naval Shipyard and NAVBASE on April 1, 1996.

CNC Corrective Action (CA) activities are being conducted under the Resource Conservation and Recovery Act (RCRA); the South Carolina Department of Health and Environmental Control (SCDHEC) is the lead agency for CA activities at the site. All RCRA CA activities are performed in accordance with the Final Permit (Permit No. SC0 170 022 560).

In April 2000, CH2M-Jones was awarded a contract to provide environmental investigation and remediation services at CNC. This submittal has been prepared by CH2M-Jones to document the basis for a No Further Action (NFA) decision for Solid Waste Management Unit (SWMU) 47 in Zone C of the CNC. Figure 1-1 illustrates the location of Zone C within the CNC.

1.1 Background

SWMU 47, a former burning dump, was identified as an area with potential contamination in the RCRA Facility Assessment (RFA) completed by EnSafe, Inc. (EnSafe) in 1995. Very little historic information about this site was found during the RFA. Awareness of the existence of this former burning dump is based on several historic engineering plans for the site, dated between 1920 and 1926, which have the phrase "Burning Dump" in an area southwest of Avenue D, in Zone C of the CNC. The precise boundaries of the burning dump are not known. The former burning dump was designated SWMU 47 in the RFA. An aerial photograph of SWMU 47 is provided as Figure 1-2.

An investigation plan for SWMU 47 was included in the work plan for the RCRA Facility Investigation (RFI) to assess the potential presence of contaminants resulting from operations at this site. Based on the investigations completed in the SWMU 47 vicinity (see Section 3.0), some reported soil concentrations exceeded the background, or reference,

concentrations; however no significant source areas of contamination were identified at SWMU 47.

Additionally, after review of available historic engineering drawings, the actual location of the former burning dump appears to be located several hundred feet from the area identified as the presumed location in the RFA. Incidentally, the area targeted for investigation during the RFA included the likely actual location of the former burning dump area. The analytical data from samples collected within the approximate footprint of the actual former burning dump area (summarized in Section 3.0 of this report) indicate that the area contains relatively low levels of contaminants, similar to reference background concentrations at the CNC. Based on lack of discernible contamination that can be clearly linked to historic operations at the former burning dump, CH2M-Jones recommends that the site be considered for NFA.

1.2 Purpose of Corrective Measures Study Work Plan

This Corrective Measures Study Work Plan (CMS WP) provides information about SWMU 47 that supports a recommendation for NFA. It provides a summary of the sampling and analysis conducted during the RFI, presents historic engineering drawings that clarify the likely actual location of the former burning dump, discusses the analytical data for samples collected nearest to or within the likely footprint area of the former burning dump, and reviews available boring logs for borings installed near or within the footprint of the former burning dump.

Prior to changing the status of any site to NFA in the CNC RCRA CA permit, the BRAC Clean-Up Team (BCT) agreed that the following issues should be considered:

- Status of the RFI
- Presence of metals (inorganics) in groundwater
- Potential linkage of SWMU / Area of Concern (AOC) to SWMU 37 (investigated sanitary sewers)
- Potential linkage of SWMU / AOC to AOC 699 (investigated stormwater sewers)
- Potential linkage of SWMU / AOC to AOC 504 (investigated railroad lines)
- Potential linkage to surface water bodies (Zone J)
- Potential contamination associated with Oil-Water Separators (OWSs)
- Relevance or need for land-use controls at the site

Information regarding the above issues is also provided in this CMS WP to expedite evaluation of closure of the site.

Provided that the information presented in this CMS WP and that responses to SCDHEC comments on this WP regarding the above issues are adequate to address these site closeout items, it is expected that the BCT may concur that NFA is appropriate for the site. At that time, a Statement of Basis will be prepared for this site that will be available for public comment in accordance with SCDHEC policy. This will allow for public participation in the final remedy selection.

1.3 Report Organization

This CMS WP consists of the following sections, including this introductory section:

1.0 Introduction — Presents the purpose of the report and background information relating to the CMS WP.

2.0 Historic Information on Former Burning Dump Location — Provides a summary of historic engineering drawings that identify the location of the former burning dump.

3.0 Summary of RFI Results for SWMU 47 — Summarizes the results of samples collected at SWMU 47, with an emphasis on samples closest to the likely location of the former burning dump.

4.0 Summary of Closeout Issues — Discusses the various site closeout issues that the BCT agreed to evaluate prior to site closeout.

5.0 Recommendations — Provides recommendations for proceeding with closeout of the site.

6.0 References — Lists the references used in this document.

Appendix A contains copies of relevant engineering drawings.

Appendix B contains the data (and a figure that presents sample locations) used in the evaluation of the benzo(a)pyrene equivalent (BEQ) reference concentration calculation.

Appendix C contains excerpts from the Zone C RFI.

Appendix D provides the soil boring logs.

- 1 **Appendix E** provides responses to SCDHEC comments on the CMS Work Plan, Rationale
- 2 for No Further Action, SWMU 47, Zone C
- 3 All tables and figures appear at the end of their respective sections.

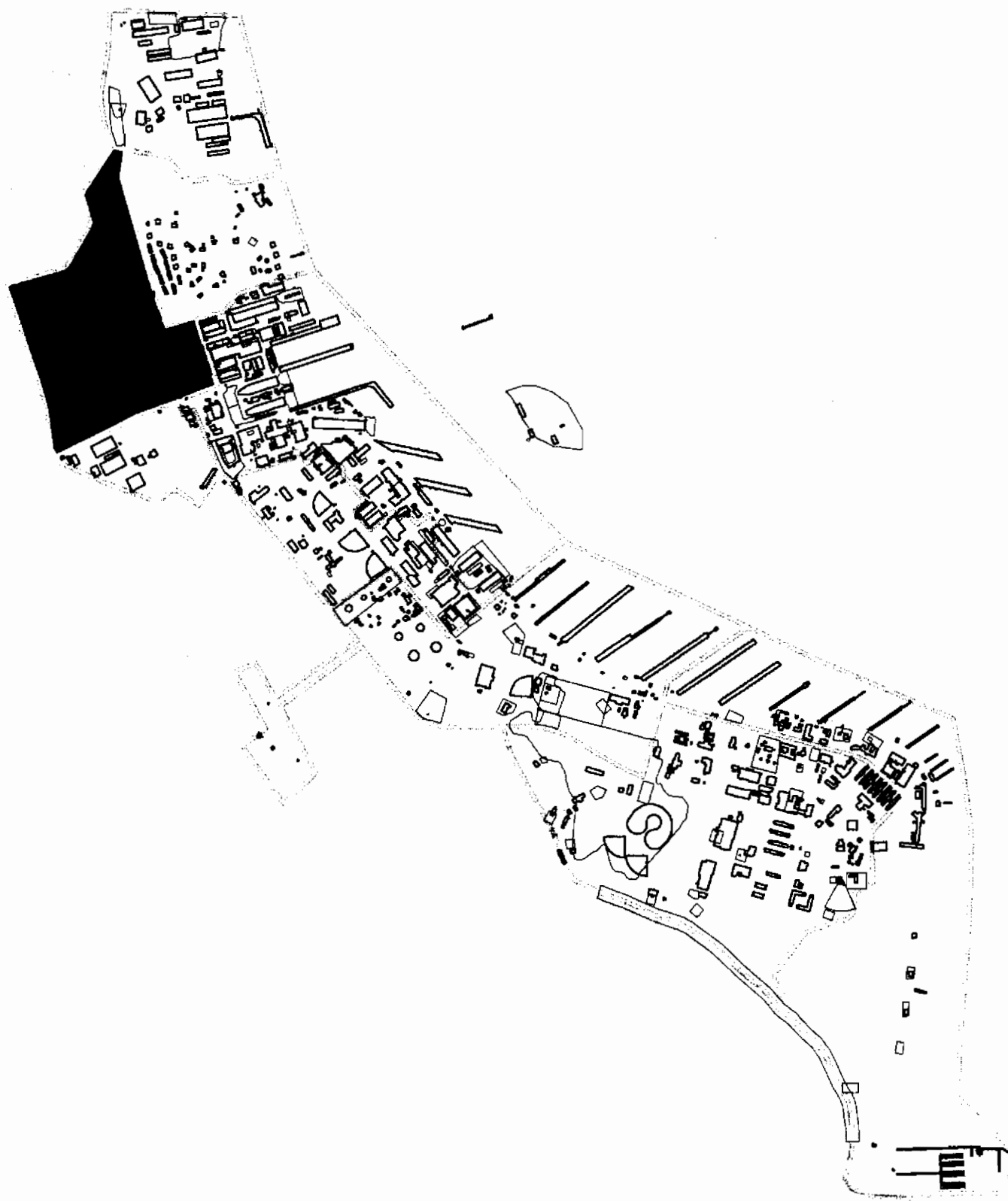
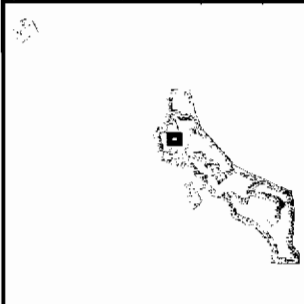
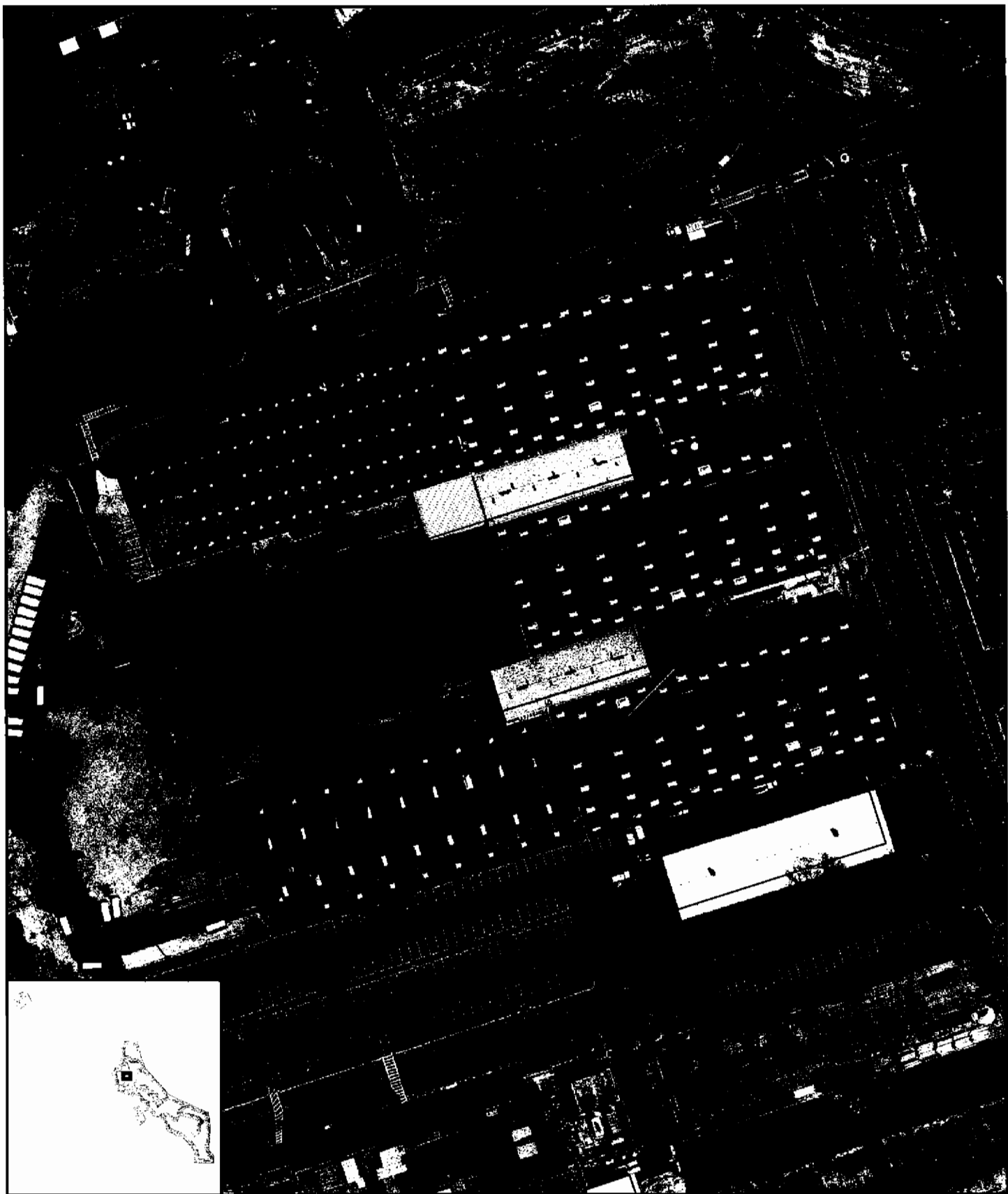







Figure 1-1
Location of Zone C
Charleston Naval Complex
North Charleston, South Carolina



-  Fence
-  AOC Boundary
-  SWMU Boundary
-  Buildings
-  Zone Boundary

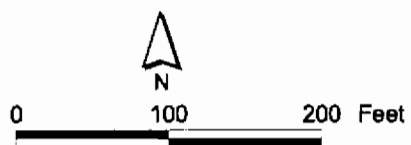


Figure 1-2
SWMU 47, Zone C
Aerial Photograph
Charleston Naval Complex

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SECTION 2.0

**Historic Information on
Former Burning Dump Location**

2.0 Historic Information on Former Burning Dump Location

2.1 Review of Historic Engineering Drawings Regarding Location of SWMU 47

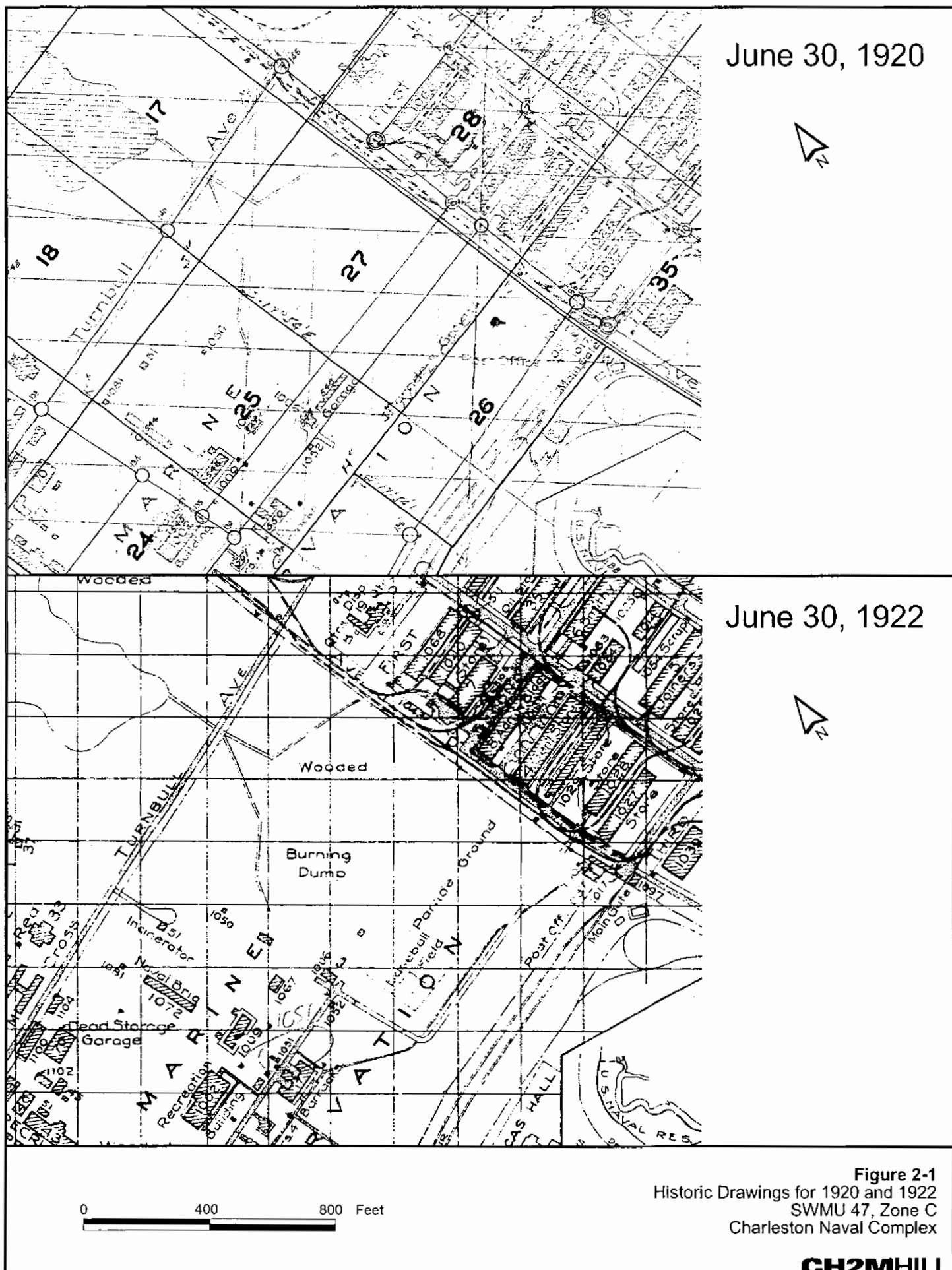
Copies of historic engineering drawings that provide the best available information about the actual location of the former burning dump are presented in Appendix A. Figures 2-1 through 2-5, at the end of this section, present excerpts from these engineering drawings for ease of presentation and review in this report.

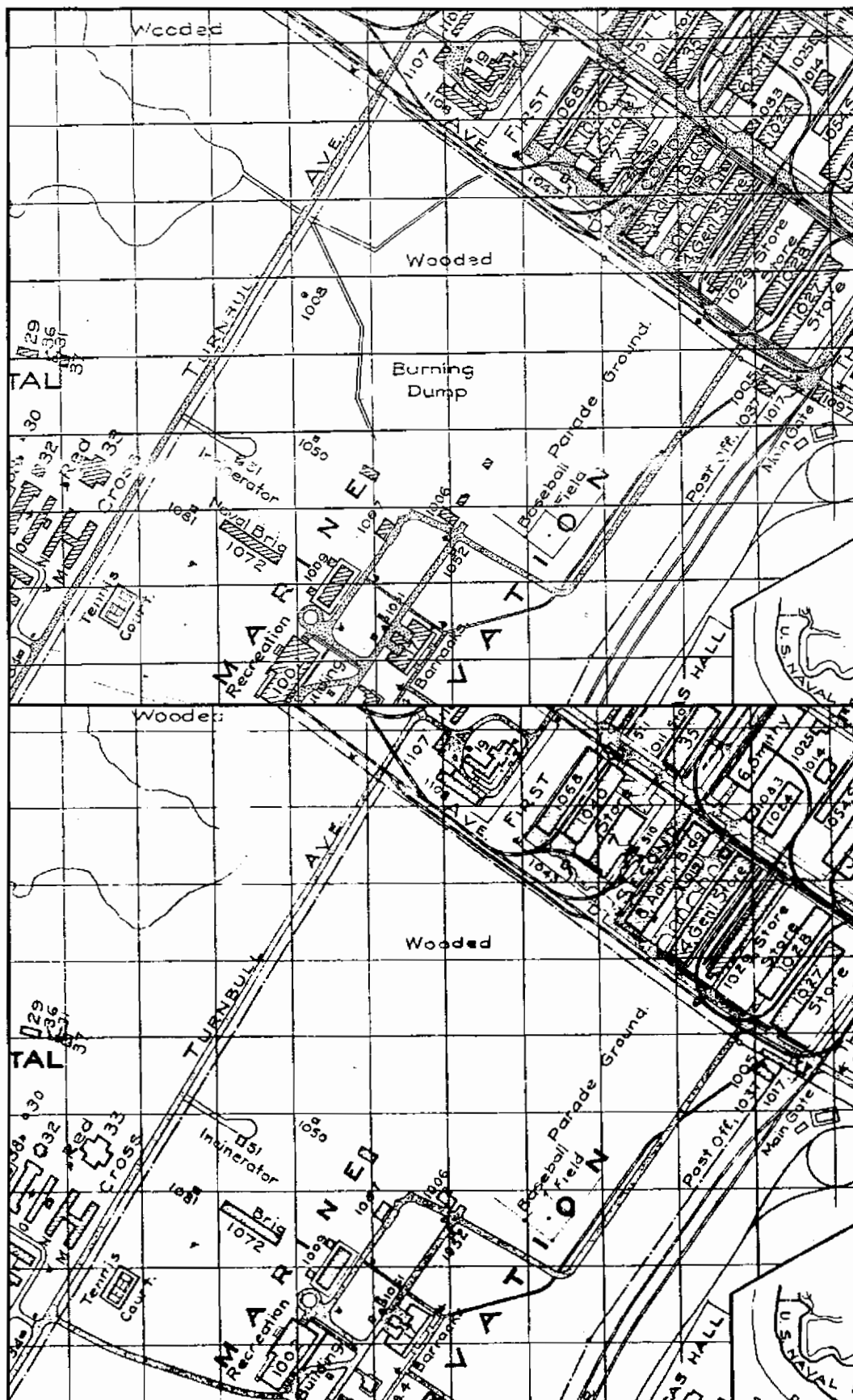
Figure 2-1 presents the area of the CNC at which the burning dump was located in 1920 and 1922. As Figure 2-1 illustrates, there is no indication that the burning dump was present on the 1920 drawing. On the 1922 drawing, the presence of the burning dump is indicated. The area to the north of the burning dump, at which the three large warehouses are currently constructed, is indicated as being wooded at that time. From this information, it is reasonable to assume that the burning dump was not present prior to 1920.

Figure 2-2 presents the area of the CNC at which the burning dump was located in 1924 and 1926. It can be seen that in 1926, references to the presence of the burning dump are no longer present. Based on this information, it is reasonable to assume that the burning dump was no longer operational after 1926.

Figure 2-3 presents the area of the CNC at which the burning dump was located in 1929 and 1935. It can be seen that references to the burning dump continue to be absent from these drawings. Also, the area to the north of the burning dump, where the three warehouses are located, continues to be indicated as wooded.

Figure 2-4 presents the area of the CNC at which the burning dump was located in 1942 and 1970. It can be seen that the warehouses that are present north of the burning dump have been or are under construction during 1942. It can also be seen that railroad tracks, which are not present today, originally provided rail service into each warehouse. The railroad tracks are still present in the drawing from 1970.





June 30, 1924



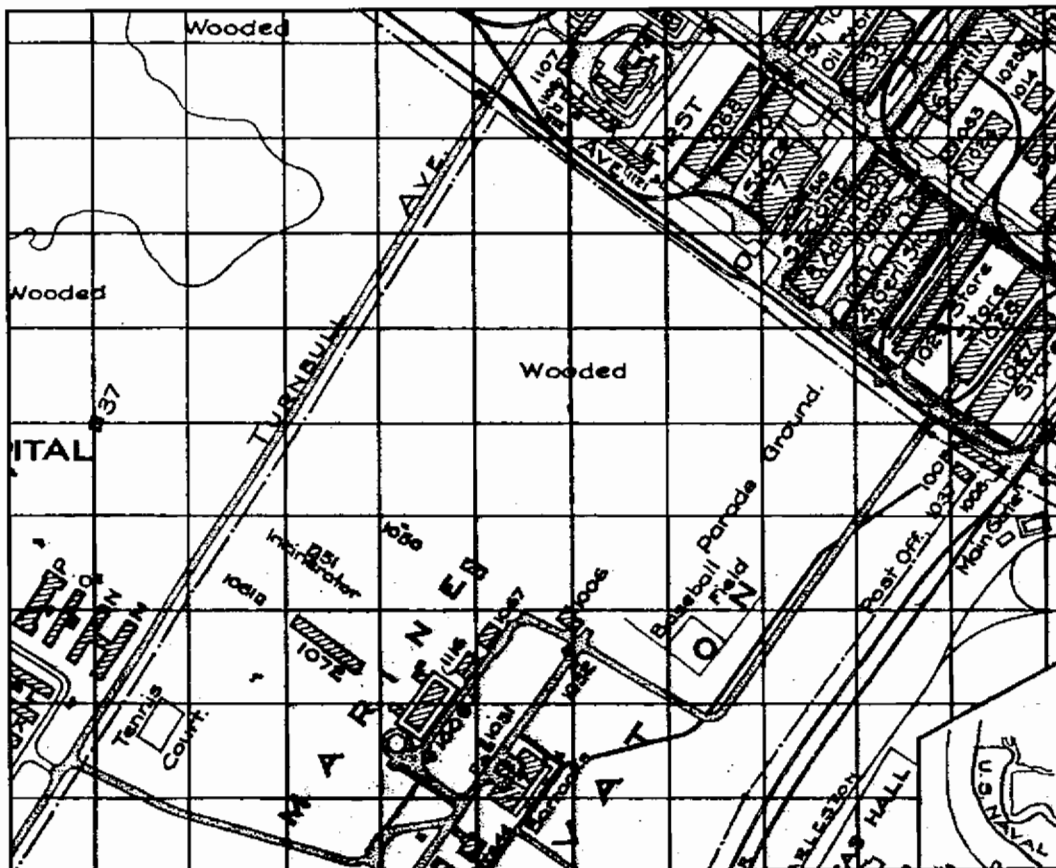
June 30, 1926



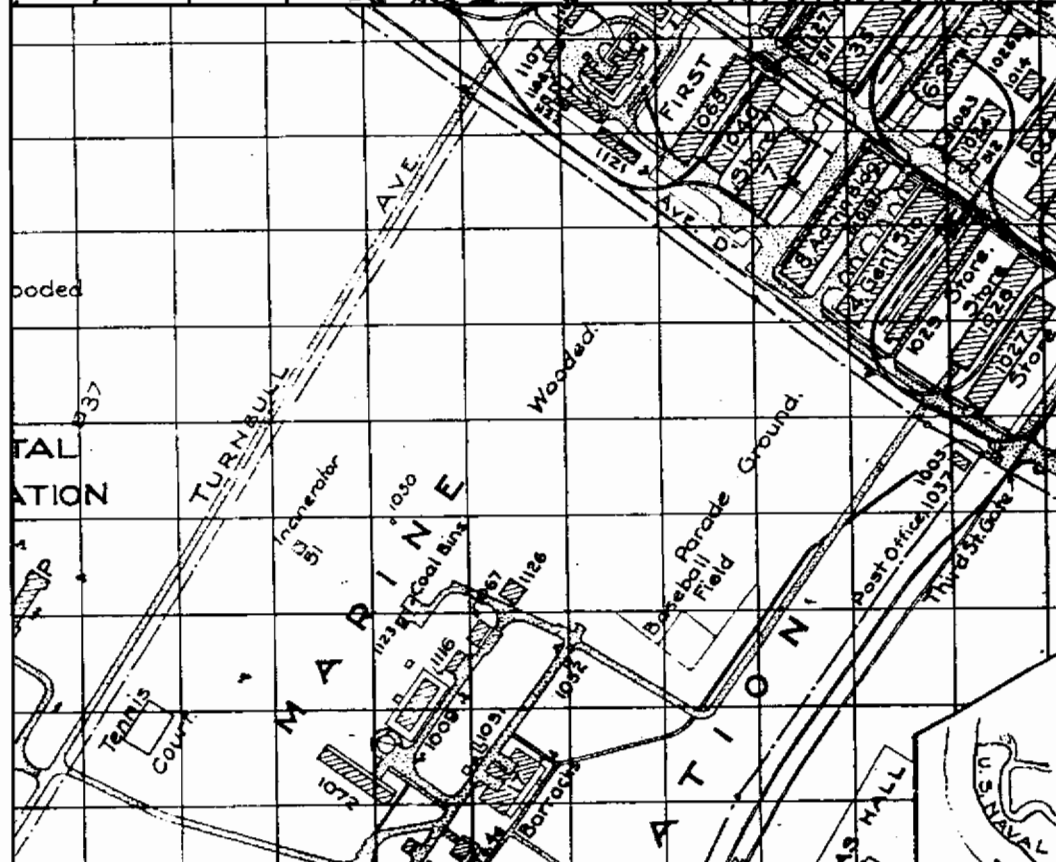
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Figure 2-2
Historic Drawings for 1924 and 1926
SWMU 47, Zone C
Charleston Naval Complex

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June 30, 1929



June 30, 1935

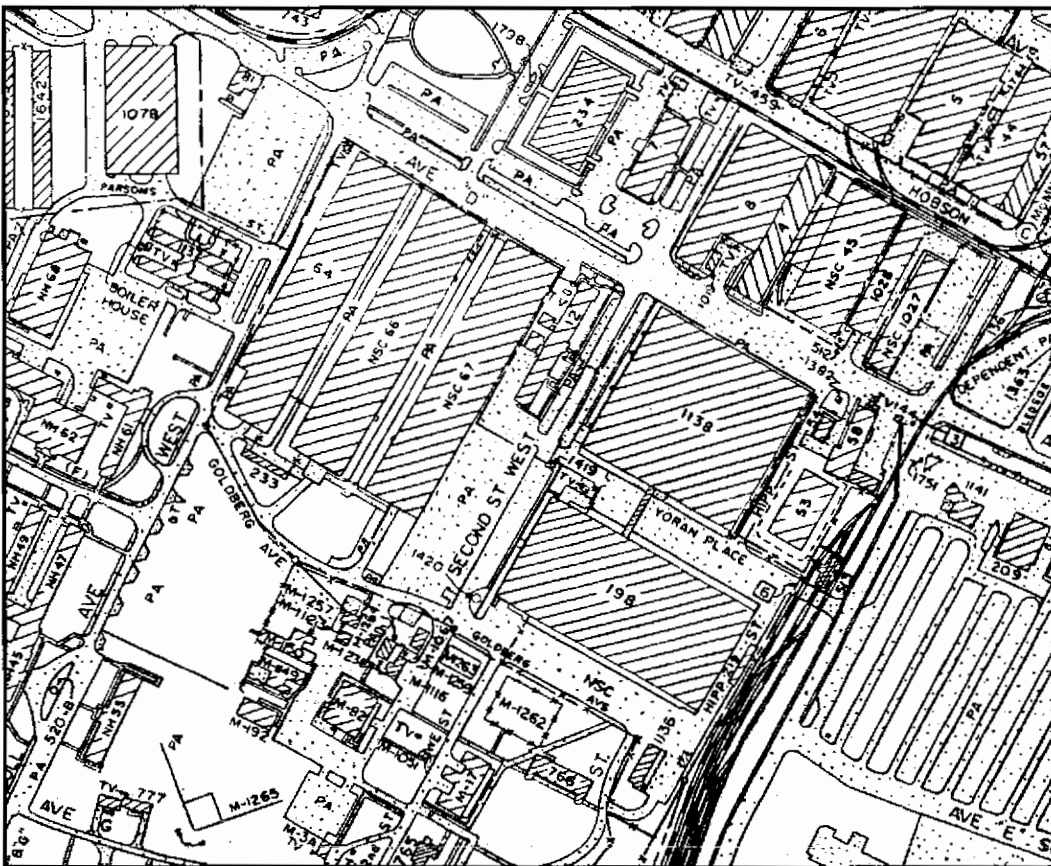


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Figure 2-3
Historic Drawings for 1929 and 1935
SWMU 47, Zone C
Charleston Naval Complex

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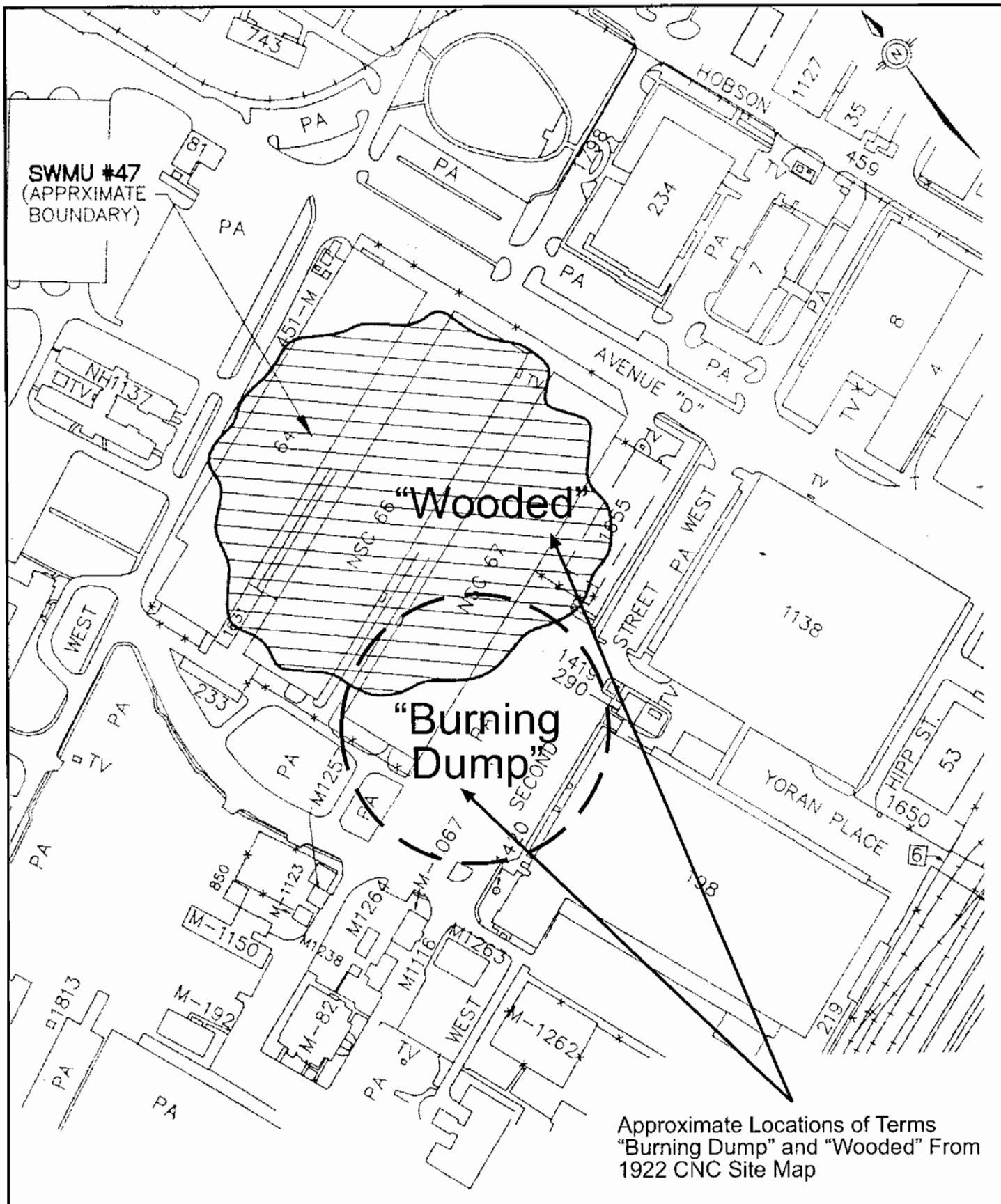
October 1, 1977



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Figure 2-5
Historic Drawings for 1977
SWMU 47, Zone C
Charleston Naval Complex

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SECTION 3.0

Summary of RFI at SWMU 47

3.0 Summary of RFI at SWMU 47

As part of the RFI for Zone C, soil and groundwater samples were collected in the vicinity of SWMU 47. The extent of the sampling are included the footprint of the warehouses, extending northwest of Avenue F and northeast of Avenue D, and near the likely location of the former burning dump, as indicated on the historic engineering drawings discussed in Section 2.0. During the RFI, AOC 516, which is adjacent to SWMU 47, was investigated concurrently with SWMU 47. The risk assessment was also completed for these two sites concurrently. As such, these areas are considered and referred to as the combined area SWMU 47/AOC 516.

A total of 22 surface soil samples (C047SB001 - C047SB013 and C047SB015 - C047SB023); 11 subsurface soil samples (C047SB001, C047SB003 - C047SB005, C047SB007 - C047SB009, C047SBSB011 - C047SB013, and C047SB015); and 14 groundwater samples (C047GW001 - C047GW013 and C047GW015) were collected and analyzed. The analytes included the full suite of parameters (i.e., metals, volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), polychlorinated biphenyls (PCBs), and pesticides).

The RFI concluded that although several parameters were detected in one or several samples above conservative screening criteria, no significantly sized source areas of contamination were identified at the combined SWMU 47/AOC 516. For heavy metals, the samples collected at 047SB007 represent a small "hot spot" area of contamination (see Figure 3-1). Soil samples collected at this location had exceedances of RBCs for lead, arsenic, and thallium. This contamination does not appear related to the former burning dump and is more likely related to the battery recharging operations at AOC 516. In conjunction with this CMS WP for NFA, CH2M-Jones also proposes excavating this "hot spot" area of metals contamination. The proposed excavation is described in the Interim Measure Work Plan (IM WP) for AOC 516, submitted to SCDHEC in November 2000 (CH2M HILL, 2000).

3.1 Brief Summary of Soil Results from the Zone C RFI

Soil sampling locations at SWMU47 / AOC 516 are presented on Figure 3-1. The approximate footprint area of the former burning dump is also indicated on Figure 3-1. The actual diameter of the burning dump is not known. The 400-foot diameter portrayed on Figure 3-1 is intended to represent the approximate area labeled "Burning Dump" on the 1922 engineering drawing.

3.1.1 Surface Soil

In the RFI, results of surface soil analyses were compared to applicable screening criteria (U.S. Environmental Protection Agency [EPA] Region III residential risk-based concentrations [RBCs] or background values). Tables 10.2.3 and 10.2.4 from the Zone C RFI (EnSafe, 1997), which summarize this comparison, are provided in Appendix C.

Analytes that exceeded the screening criteria were further evaluated in the risk assessment to determine which of these parameters were chemicals of concern (COCs) (Section 10.2.6, Zone C RFI). The results of the risk assessment for surface soil, page 10.2.59 of the Zone C RFI, are also included in Appendix C. This analysis resulted in the identification of the following COCs for surface soil at the combined AOC 516/SWMU 47:

- Arsenic
- Beryllium
- Thallium
- BEQs

Table 3-1 summarizes the surface soil data for these constituents collected in the vicinity of SWMU 47, as described in the Zone C RFI. Table 3-2 presents the data collected in the vicinity of the presumed location of the burning dump. Each constituent is discussed below.

Arsenic

Arsenic was detected in seven surface soil samples collected during the SWMU 47 investigation. Of these, one sample location (C047SB007, 28.7 milligrams per kilogram [mg/kg]) was reported above the reference concentration of 14.1 mg/kg, but below the soil screening level (SSL) of 29 mg/kg using a dilution attenuation factor (DAF) of 20. The four sample locations around this location were all reported below the reference concentration, indicating a limited area of arsenic-containing soil. An IM WP for AOC 516 recommended removal of this small area of soil. No other surface soil samples collected during the RFI indicated arsenic exceedances of the reference concentration.

Within the presumed area of the burning dump, no samples reported arsenic above the reference concentration. Table 3-2 provides the data for the stations and results included in the analysis. Therefore, arsenic in surface soil does not warrant further investigation at SWMU 47.

Beryllium

Beryllium was identified as a COC in the risk assessment of the combined AOC 516/SWMU 47. Review of the data relevant to the evaluation of SWMU 47 (see Table 3-1) indicates that beryllium was detected in 3 of 14 samples collected at SWMU 47. All of the detections were estimated values, as indicated by the "J" qualifier. A reference concentration for beryllium in Zone C surface soil was not determined, as beryllium was not detected in more than 90 percent of the background samples. As a result, the RFI used the detection limit as the reference concentration. The EPA has established an RBC for beryllium of 160 mg/kg (Region III, RBC table, April 2000). No sample collected at SWMU 47 reported a beryllium concentration above this RBC value.

Within the presumed area of the burning dump, no samples reported beryllium above the RBC (160 mg/kg). Table 3-2 provides the data for the stations and results included in the analysis. Therefore, beryllium in surface soil does not warrant further investigation at SWMU 47.

Thallium

Table 3-1 illustrates that thallium was detected in a single surface soil sample (C047SB007 2.1 mg/kg) collected in SWMU 47. This value is above the reference concentration (the detection or reporting limit) and the SSL (0.7 mg/kg). The detected concentration is below the EPA residential RBC of 5.5 mg/kg. Additionally, the proposed removal of arsenic-containing soil (AOC 516 IM WP) will include the removal of this small area of thallium-containing soil.

Within the presumed area of the burning dump, thallium was not detected in any SWMU 47 sample. Table 3-2 provides the data for the stations and results included in the analysis. Therefore, thallium in surface soil does not warrant further investigation at SWMU 47.

BEQs

Polynuclear aromatic hydrocarbons (PAHs), expressed as BEQs, were identified as a COC in the RFI report prepared by EnSafe at the combined AOC 516/SWMU 47, based on exceedances of the RBC of 88 micrograms per kilogram ($\mu\text{g}/\text{kg}$). PAHs are routinely detected in non-impacted as well as impacted areas of the CNC. The detected PAHs, and resulting calculated BEQs in the non-impacted areas (grid-based samples) of the CNC were used to calculate a BEQ value for use as a basewide reference concentration. The data and analysis were presented in the Background PAHs Study Report - Technical Information for

1 Development of Background BEQ Values, Rev. 0, February 2001, presented to the BCT. The
2 BEQ reference concentration is 1,304 µg/kg for surface soil.

3 Comparison of calculated BEQ values from SWMU 47 to the CNC reference concentration
4 resulted in 2 BEQ exceedances of 64 samples (3.1 percent) collected and analyzed for PAHs
5 at SWMU 47. Both exceedances are located near the northeast corner of the site, as indicated
6 in the RFI (EnSafe, 1997). C047SB005 (7,648.5 µg/kg) is located next to Turnbull Avenue
7 West, and C047SB016 (5,169.6 µg/kg) is located across Avenue D. These two sample
8 locations are remote from the location of the burning dump, as discussed in Section 2.0, and
9 are not likely related to burning dump operations.

10 It can also be seen in Figures 2-1 through 2-4 that railroad tracks were located along
11 Avenue D, very close to sample location C047SB016. Railroad tracks can be seen on the
12 earliest available engineering drawing (June 1920, Figure 2-1). After the construction of
13 Buildings 64, 66, and 67, sometime between June 1935 and June 1942, rail service was
14 connected to these buildings. The railroad can be seen in the July 1970 (Figure 2-4)
15 engineering drawing, but not in the October 1977 (Figure 2-5) engineering drawing,
16 indicating that the railroad tracks were present in this area for at least 50 years and removed
17 between July 1970 and October 1977. Creosote (railroad ties), petroleum products, train
18 engine emissions, and engine oil leakage from railroad operations are all sources of PAHs.

19 Both sampling locations are located between asphalt roads and asphalt parking areas. The
20 site is located within a high traffic, industrial area of the base, with extensive asphalt paved
21 areas. Pavement, motor vehicle emissions, and petroleum products are all sources of PAHs.
22 Thus, activities not associated with operations of the burning dump or with SWMU 47
23 likely contributed to the PAHs at these sampling locations.

24 The mean BEQ concentration within the site, as described in the RFI (1,203.2 µg/kg), is
25 below the reference concentration.

26 Within the presumed area of the burning dump, reported BEQ values are all below the
27 CNC reference concentration. Based on the above information, further evaluation, or
28 remediation, of BEQs is not warranted at SWMU 47.

29 **3.1.2 Subsurface Soil**

30 Subsurface soil samples were collected as part of the RFI at each of the soil boring locations.
31 Figure 3-1 illustrates the locations of the soil samples analyzed as part of this CMS WP.

Results of subsurface soil analyses in the RFI were compared to applicable screening criteria (EPA SSLs or background values). Analytes detected in subsurface soils were either not detected above their respective SSLs or not reliably identified in shallow groundwater, indicating that existing soil concentrations are protective of surficial groundwater. Page 10.2.18 (Section 10.2.5.1) of the Zone C RFI is included in Appendix C for reference.

Thallium was detected in subsurface soil (C047SB007 1.8 mg/kg) above its SSL and background value, but was detected only once in the groundwater sample (C047GW007 3.9 J micrograms per liter [$\mu\text{g/L}$]) collected at the same location. This is an estimated value, as indicated by the "J" qualifier. During two previous sampling events, thallium was not detected at that location. Additionally, thallium was not detected in a sample collected from the same well one month later, indicating that AOC 516 soil is not likely leaching to the surficial aquifer.

Based on these data, the risk assessment did not identify any COCs for subsurface soil at AOC 516/SWMU 47.

3.1.3 Groundwater

Groundwater samples that were collected as part of the RFI were compared to applicable screening criteria (EPA Region III residential RBCs or reference concentrations). Figure 3-2 illustrates the locations of groundwater samples collected at SWMU 47.

Analytes that exceeded the screening criteria were further evaluated in the risk assessment to determine which of these parameters were COCs (Section 10.2.6, Zone C RFI). The results of the risk assessment for groundwater, page 10.2.63 of the Zone C RFI (EnSafe, 1997), are included in Appendix C. This analysis resulted in the identification of arsenic as the sole COC for groundwater at the combined AOC 516/SWMU 47. Arsenic data for SWMU 47 are included in the discussion of inorganics in groundwater in Section 4.0, Table 4-1.

Review of relevant groundwater data for SWMU 47 indicates that all maximum contaminant level (MCL) ($50 \mu\text{g/L}$) exceedances occurred at a single location (C047GW011). This sample was collected outside the presumed location of the burning dump. The first sampling event at this location produced samples that were below the MCL. Three subsequent sampling efforts between January and June 1996 reported arsenic concentrations approximately three times the MCL. After completion of the RFI, two additional sampling events were conducted in January and July of 1999, from which five results reported no exceedances of the MCL. The January 1999 sampling event reported filtered and unfiltered results of 28.2 and 48.2 $\mu\text{g/L}$, respectively, indicating that

approximately 59 percent of the detected arsenic concentration was attributable to suspended solids in the sample. The July 1999 sampling event reported arsenic concentrations of 22.3, 4.2 J, and 3.4 J $\mu\text{g/L}$.

An explanation for the increased arsenic concentration is not apparent. The most recent groundwater sampling results indicate that arsenic concentrations are below the MCL in all groundwater wells at SWMU 47.

3.2 Review of Soil Boring Logs

Available boring logs collected within the approximate footprint of the former burning dump were reviewed to determine the presence of ash or waste material. Two logs, one each for borings C047SB001 and C047SB008, were located and are provided in Appendix D. Neither log indicates that any ash or solid waste was encountered in the soil profile.

3.3 Summary

The former burning dump operated for approximately 5 to 6 years between 1920 and 1926. Although some soil samples at SWMU 47/AOC 516 exceeded conservative screening criteria, no significant source areas of contamination were identified. In addition, no significant contamination was identified within the footprint area of the likely presumed location of the former burning dump. A review of boring logs in the former burning dump vicinity did not show the presence of ash or waste material layers. Overall, there is no apparent contamination at SWMU 47/AOC 516 from operations at the former burning dump.

Surface soil sample C047SB00701 was found to contain arsenic and thallium at concentrations above their reference concentrations, but below levels that represent a risk to shallow groundwater. The thallium concentration was below the residential RBC of 5.5 mg/kg. Lead was also identified above its residential cleanup goal of 400 mg/kg.

The results of surface samples collected around C044SB007 (C516SBC01 through C516SBC04) were all less than the arsenic reference concentration and the lead residential cleanup goal, indicating a small area of impact of these constituents. An IM WP was developed for AOC 516 that recommended excavation of the contaminated soil around C047SB007.

- 1 Once the contaminated soil is excavated around C047SB007, SWMU 47 soil will be suitable
- 2 for unrestricted land use, as no surface soil COC identified in the RFI will exceed
- 3 appropriate screening criteria (reference concentrations).
- 4 No subsurface soil COCs were identified in the risk assessment for SWMU 47.
- 5 Recent data suggest that groundwater concentrations of arsenic, the sole COC identified in
- 6 the Zone C RFI (EnSafe, 1997) for SWMU 47, are below applicable screening criteria (MCL).

TABLE 3-1
SWMU 47 Surface Soil Data for Arsenic, Beryllium, Thallium, and BEQs
CMS Work Plan, NFA, SWMU 47 in Zone C, Charleston Naval Complex

Station ID	Sample ID	Collection Date	Arsenic Result/Qualifier (mg/kg)	Beryllium Result/Qualifier (mg/kg)	Thallium Result/Qualifier (mg/kg)	BEQ Result/Qualifier (mg/kg)
C047SB001	047SB00101	4/3/95	0.38 J	0.22 U	0.53 U	540.5 =
C047SB002	047SB00201	4/3/95	1.1 J	0.13 U	0.5 U	566.7 =
C047SB003	047SB00301	4/13/95	4.4 =	0.33 U	0.56 U	801.7 U
C047SB004	047SB00401	4/13/95	0.36 UJ	0.11 U	0.5 U	731.4 U
C047SB005	047SB00501a	3/31/95	1.7 UJ	0.19 UJ	0.48 U	7,648.5 =
C047SB006	047SB00601b	3/31/95	4.1 UJ	0.15 UJ	0.47 U	736.0 =
C047SB007	047SB00701b	4/14/95	27.8 =	0.38 J	2.1 =	841.0 =
C047SB008	047SB00801	4/14/95	3 J	0.49 U	0.5 U	643.3 =
C047SB009	047SB00901	4/14/95	8.6 =	0.36 J	0.51 U	984.8 =
C047SB010	047SB01001	4/14/95	3.3 =	0.5 J	0.57 U	807.7 U
C047SB011	047SB01101	4/13/95	0.34 UJ	0.38 U	0.48 U	797.3 =
C047SB012	047SB01201	4/13/95	3 J	0.1 U	0.47 U	360.8 =
C047SB013	047SB01301	4/13/95	0.35 UJ	0.13 U	0.49 U	684.1 U
C047SB015	047SB01501	4/13/95	0.34 UJ	0.08 U	0.47 U	672.5 U
C047SB016	047SB01601	4/10/95	0.62 J	NA	NA	5,169.6 =
C047SB017	047SB01701	4/10/95	9.6 J	NA	NA	595.4 =
C047SB018	047SB01801	7/6/95	NA	NA	NA	866.7 =
C047SB019	047SB01901	7/6/95	NA	NA	NA	365.3 =
C047SB020	047SB02001b	7/6/95	NA	NA	NA	701.6 U
C047SB021	047SB02101	7/5/95	NA	NA	NA	720.3 U
C047SB022	047SB02201	7/5/95	NA	NA	NA	505.0 =
C047SB023	047SB02301	7/5/95	NA	NA	NA	730.8 U

Bold values are exceedances of reference values. Reference concentration for beryllium is the detection limit.

NA indicates that the analyte was not analyzed for in the sample.

U indicates that the analyte was not detected; the reported value is the detection limit.

UJ indicates that the analyte was not detected; the reported value is an estimated detection limit.

J indicates that the analyte was detected; the reported value is an estimated concentration.

= indicates that the analyte was detected; the reported value is equal to the sample concentration.

Note: BEQ values were calculated using a value of half the detection limit for constituents with a "U" qualifier.

TABLE 3-2

SWMU 47 Surface Soil Data for Arsenic, Beryllium, Thallium, and BEQs within the Presumed Burning Dump Area
 CMS Work Plan, NFA, SWMU 47 in Zone C, Charleston Naval Complex

Station ID	Sample ID	Collection Date	Arsenic Result/Qualifier (mg/kg)	Beryllium Result /Qualifier (mg/kg)	Thallium Result/Qualifier (mg/kg)	BEQ Result/Qualifier (mg/kg)
C047SB008	047SB00801	4/13/95	3.00 J	0.49 U	0.50 U	643.3 =
C047SB009	047SB00901	4/14/95	8.60 =	0.36 J	0.51 U	984.8 =
C047SB001	047SB00101	4/3/95	0.38 J	0.22 U	0.53 U	540.5 =
CGDCSB026	GDCSB02601	4/17/95	0.74 J	0.21 UJ	0.48 U	NA

NA indicates that the analyte was not analyzed for in the sample.

U indicates that the analyte was not detected; the reported value is the detection limit.

UJ indicates that the analyte was not detected; the reported value is an estimated detection limit.

J indicates that the analyte was detected; the reported value is an estimated concentration.

= indicates that the analyte was detected; the reported value is equal to the sample concentration.

Note: BEQ values were calculated using a value of half the detection limit for constituents with a "U" qualifier.

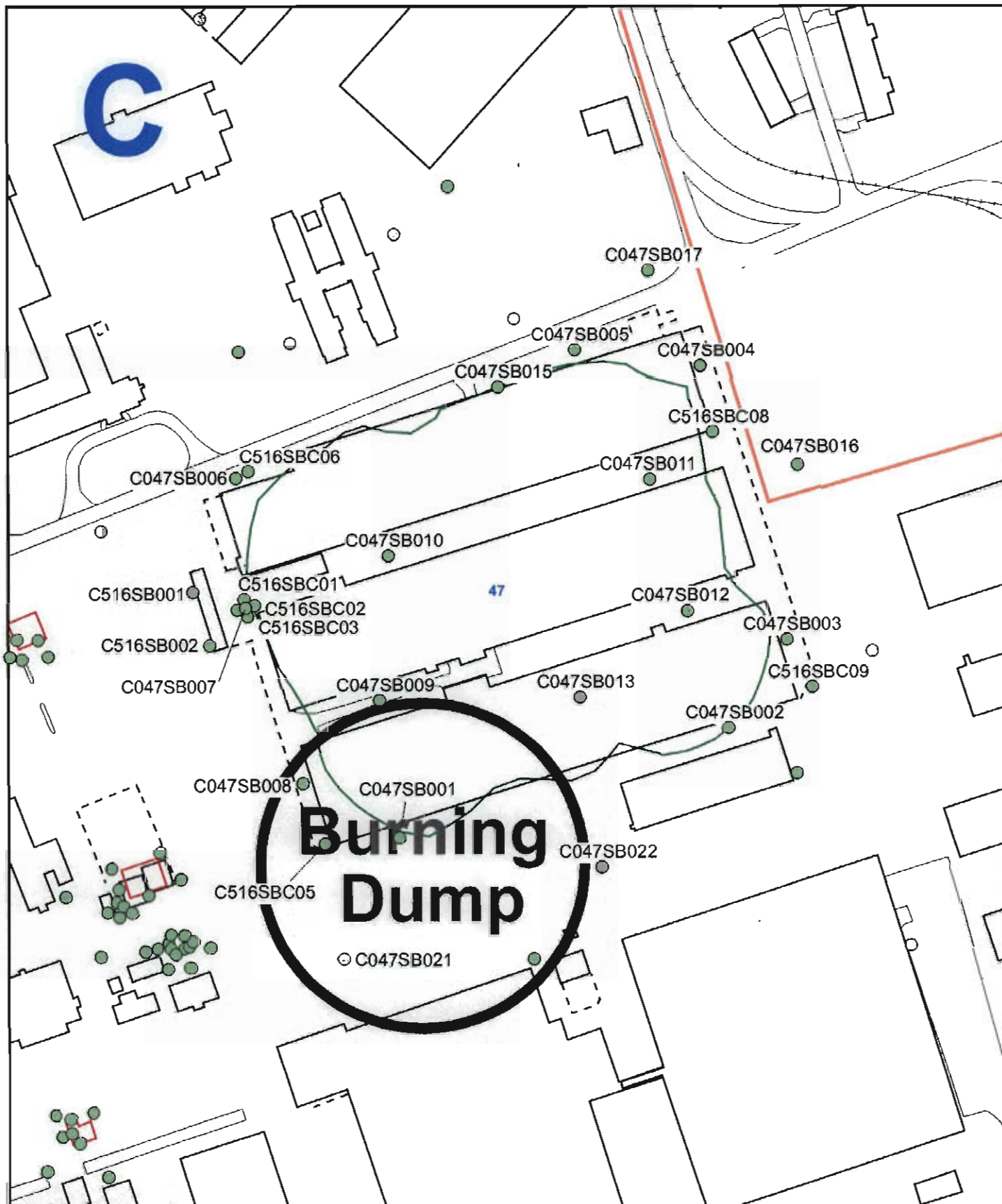


Figure 3-1
Soil Sample Locations
SWMU 47, Zone C
Charleston Naval Complex

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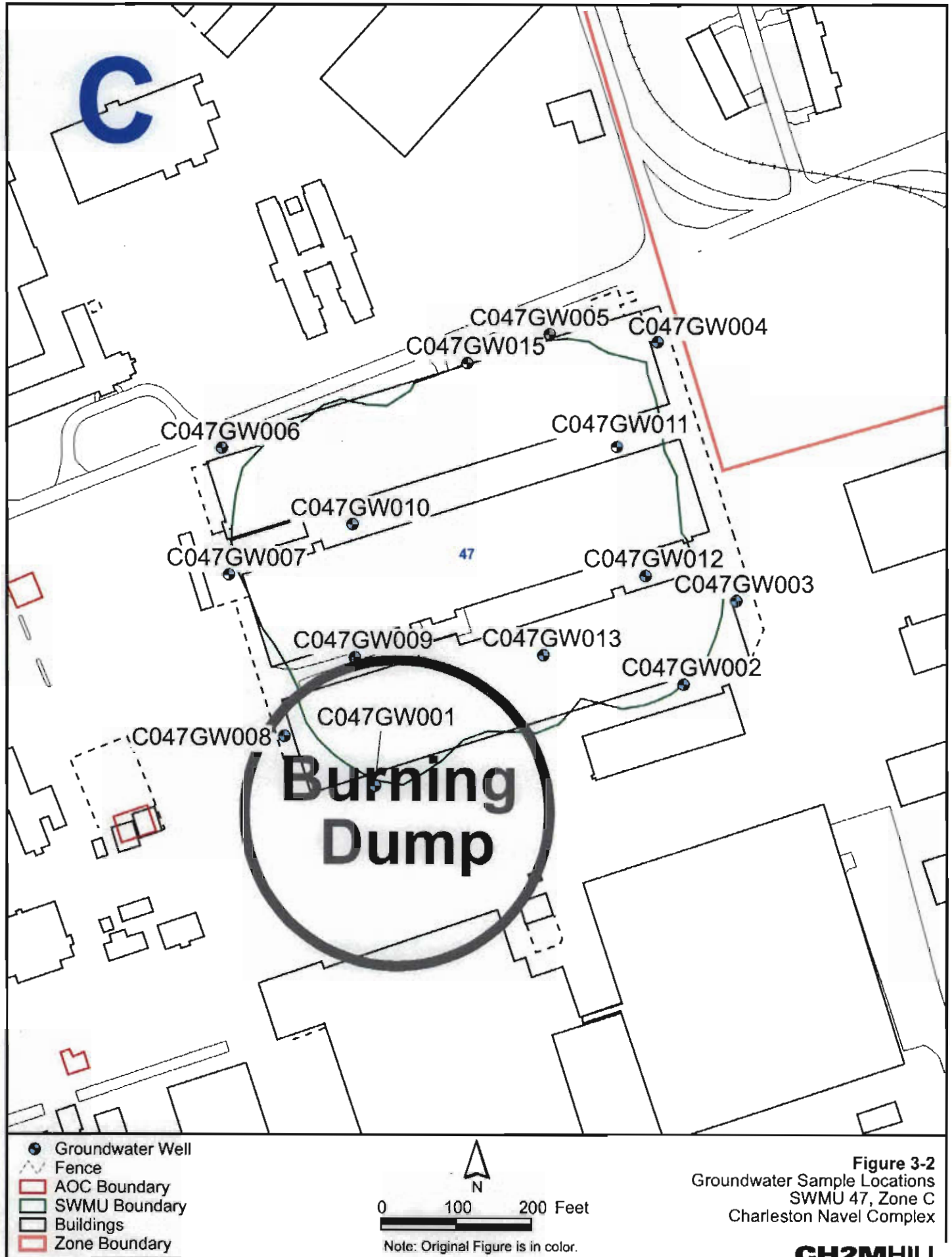


Figure 3-2
Groundwater Sample Locations
SWMU 47, Zone C
Charleston Naval Complex

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SECTION 4.0

**Summary of Information
Related to Site Closeout Issues**

4.0 Summary of Information Related to Site Closeout Issues

4.1 Presence of Inorganics in Groundwater

For the purpose of site closeout documentation, the inorganics in groundwater issue refers to the occasional or intermittent detection of several metals (primarily arsenic, thallium, and antimony) in groundwater at concentrations above the applicable MCL, preceded or followed by detections of these same metals below the MCL, or below the practicable quantitation limit.

Groundwater samples collected in the vicinity of SWMU 47 (C047GW001 to C047GW013 and C047GW015) were evaluated as part of this CMS WP for groundwater quality. DPT groundwater samples were also collected, but were not compared to groundwater criteria as they were noted to have suspended solids in these samples, which cause results that are not representative of the groundwater quality. Data from the groundwater wells are presented in Table 4-1. A brief discussion of the presence of these analytes is presented below.

In the discussion of inorganics in groundwater, it is necessary to establish the direction of groundwater flow. The Zone C RFI (EnSafe, 1997) evaluated groundwater level measurements and determined the direction of groundwater flow throughout Zone C. In the area of SWMU 47, the general direction of groundwater flow is to the east-southeast. A map of the shallow groundwater elevations was provided in Section 2.2.5 of the RFI (page 2.15). Appendix C contains this figure for reference.

4.1.1 Arsenic

Arsenic was detected above its MCL (50 µg/L, Table 4-1) in 3 of 63 samples (4.8 percent) collected at SWMU 47. All three exceedances were at a single location (C047GW011). Two subsequent sampling efforts at this location were reported below the MCL, indicating that the elevated arsenic concentrations were transient at this location. Recent data suggest that groundwater concentrations of arsenic are below applicable screening criteria (MCL). No potential source of arsenic has been identified near C047GW011 or at SWMU 47, and no hydraulically downgradient well near the site exhibited arsenic concentrations exceeding the MCL. Arsenic data for downgradient wells are provided in Table 4-2 and Figure 4-1

illustrates the locations of the wells. The reason for the transient increase in arsenic concentrations at well C047GW011 is not known, but current data indicate that arsenic concentrations are below the MCL. As such, further investigation of arsenic in groundwater is not warranted.

4.1.2 Antimony

The data presented in Table 4-1 indicate that antimony was detected above its MCL of 6 µg/L once in 63 samples (1.6 percent) collected at SWMU 47. The exceedance was noted at C047GW001 during the first sampling round at an estimated concentration (as indicated by the "J" qualifier) of 53.1 J µg/L. The four subsequent sampling efforts at this location all reported that antimony was not detected. The low frequency of detection and absence of any non-qualified detections indicate that this detection of antimony is not likely to be site-related. Therefore, antimony does not require further evaluation at SWMU 47.

4.1.3 Thallium

Thallium was detected above its MCL of 2 µg/L (see Table 4-1) in 4 of 63 samples (6.3 percent) collected at SWMU 47. The detections were at four different locations (C047GW002, C047GW005, C047GW007, and C047GW015), primarily around the periphery of Buildings 0064, NSC 66, and NSC 67, and ranged in estimated concentrations (as indicated by the "J" qualifier), from 2.8 J to 4.3 J µg/L. The proposed excavation area for arsenic-contaminated soils related to AOC 516 activities is around sample location C047GW007. C047GW005 and C047GW015 are located along Turnbull Avenue West near Avenue D. This location is north of the presumed location of the burning dump, as described in Section 2.0 of this CMS WP. Therefore, exceedances of screening criteria at these locations are not believed to be related to burning dump activities. Additionally, the sporadic nature of the detections and the lack of non-qualified detections, combined with the very low frequency of detections (less than 7 percent), indicate that the thallium detections are not likely site-related. Therefore, further evaluation of thallium at SWMU 47 is not warranted.

4.2 Potential Linkage to Sanitary Sewers (SWMU 37)

There is no evidence to suggest or indicate that the former burning dump was ever connected in any way to the CNC sanitary sewer system. Based on the lack of infrastructure development in the vicinity of SWMU 47 at the time the burning dump operated (1920-1926), it is likely that the sanitary sewers had not been constructed at that time.

Consequently, further evaluation of a potential linkage of SWMU 47 to the sanitary sewers is not warranted.

4.3 Potential Linkage to Storm Sewers (AOC 699)

Potential linkage of a SWMU or AOC to the storm sewer refers to the possibility of a groundwater plume at a SWMU or an AOC migrating into a stormwater sewer from within which it would subsequently migrate to the water bodies around the CNC, or to the presence of a cross connection between the sanitary sewer and storm sewer, which could transport pollutants directly to surface waters. Regarding the first of these potential linkages, because the most recent data suggest that there are no contaminants currently present above their respective MCLs in site groundwater, there is no contaminated groundwater plume to migrate to a storm sewer. Therefore, no potential linkage of this SWMU to a storm sewer exists.

Regarding the second potential linkage issue, there is no data or information indicating that the former burning dump was ever connected to the CNC storm sewer system. Therefore, further evaluation of a potential linkage between SWMU 47 and the storm sewers is not warranted.

4.4 Potential Linkage to Railroad Lines (AOC 504)

The potential linkage of a SWMU or an AOC to a railroad potentially applies only to SWMUs or AOCs at which an investigated portion of the railroad system, identified as AOC 504 in the *Zone L RFI Work Plan*, passes through or directly adjacent to the AOC or SWMU.

No railroad lines are adjacent to SWMU 47. The nearest railroad lines, identified as part of AOC 504 in the *Zone L RFI Work Plan*, are located more than 200 feet to the northeast of the site. Based on this information, further evaluation of a potential linkage between the AOC 504 and the subject site is not necessary.

4.5 Potential Migration Pathways to Surface Water Bodies

Surface water was studied separately as part of the *Zone J Draft RCRA Facility Investigation Report* (EnSafe, 2000). The *Zone J Draft RCRA Facility Investigation Report* includes the investigated surface water bodies. The nearest investigated surface water bodies to

1 SWMU 47 are tributaries of Noisette Creek, approximately 1,700 feet to the north-northwest.
2 The Cooper River is approximately 2,000 feet to the east.

3 There are two possible migration pathways for contaminants to affect surface water:
4 overland flow via stormwater runoff and subsurface flow via groundwater. The fact that a
5 source area of contamination was not identified at SWMU 47, and that the nearest water-
6 receiving body is 1,700 feet to the north-northwest, indicates that surface water runoff from
7 SWMU 47 would not be an ecological concern at Noisette Creek. The only surface soil
8 sample with elevated concentrations of COCs at SWMU 47 was a single sample location
9 (C047SB007) near AOC 516, indicating an extremely small impacted area. The proposed IM
10 for AOC 516 will remove the contaminated soil at this location; Therefore, further
11 evaluation of a potential pathway for contaminant migration via stormwater runoff is not
12 warranted.

13 A groundwater contaminant plume above applicable MCLs was not reliably identified at
14 SWMU 47. Therefore, further evaluation of a potential contaminant migration via
15 groundwater migration is not warranted.

16 **4.6 Potential Contamination in Oil-Water Separators**

17 The potential contamination of oil-water separators (OWSs) issue refers to the possible
18 presence of an OWS that has not yet been investigated at a SWMU or AOC as part of the
19 RCRA or underground storage tank (UST) process.

20 Neither the RFA nor the RFI refers to the presence or possible presence of an OWS at
21 SWMU 47. In addition, there is no data indicating that OWSs were used at the CNC during
22 the period that the former burning dump was operated (1920-1926). Therefore, further
23 evaluation of this issue at SWMU 47 is not warranted.

24 **4.7 Land-Use Control Management Plan**

25 Following completion of the AOC 516 removal action, with a goal to reduce COC
26 concentrations to levels acceptable for unrestricted use, land-use controls are not expected
27 to be necessary at SWMU 47.

TABLE 4-1
 SWMU 47 Groundwater Results for Arsenic, Antimony, and Thallium
 CMS Work Plan, NFA, SWMU 47 in Zone C, Charleston Naval Complex

Station ID	Sample ID	Collection Date	Antimony Result/Qualifier ($\mu\text{g/L}$)	Arsenic Result/Qualifier ($\mu\text{g/L}$)	Thallium Result/Qualifier ($\mu\text{g/L}$)
C047GW001	047GW00101b	6/14/95	53.1 J	6.1 J	4.5 U
	047GW00102	1/25/96	2.1 U	10.9 =	2.7 U
	047GW00103	5/9/96	2.1 U	7.5 J	2.7 UJ
	047GW00104	6/7/96	3.1 U	8.6 J	2.7 UJ
	047GW001F5	1/15/99	2.7 U	25.3 J	3.1 U
	047GW001U5	1/15/99	2.7 U	25.3 J	3.1 U
C047GW002	047GW00201b	6/14/95	1.9 U	9.2 J	4.5 U
	047GW00202	1/25/96	2.1 U	10.5 =	2.7 U
	047GW00203	5/8/96	2.1 U	9 J	2.7 UJ
	047GW00204	6/7/96	2.1 U	12 J	3.9 J
C047GW003	047GW00301b	6/14/95	1.9 U	3.2 U	4.5 U
	047GW00302	1/24/96	2.1 U	2.5 U	2.7 U
	047GW00303	5/8/96	2.1 U	2.5 UJ	2.7 UJ
	047GW00304	6/10/96	2.1 U	2.5 UJ	2.7 UJ
C047GW004	047GW00401b	6/15/95	1.9 U	3.2 U	4.5 U
	047GW00402	1/25/96	2.1 U	4.6 J	2.7 U
	047GW00403	5/13/96	13 UJ	2.5 UJ	3.4 U
	047GW00404	6/10/96	2.1 U	6.6 J	2.7 UJ
C047GW005	047GW00501b	6/14/95	1.9 U	3.2 U	4.5 U
	047GW00502	1/24/96	2.1 U	9.2 J	3.9 U
	047GW00503	5/13/96	13 UJ	2.5 UJ	4.3 J
	047GW00504	6/10/96	2.1 U	2.5 UJ	2.7 UJ
C047GW006	047GW00601b	6/15/95	1.9 U	7.1 J	4.5 U
	047GW00602	1/24/96	2.1 U	3.8 J	5.1 U
	047GW00603	5/14/96	13 UJ	2.5 UJ	3.4 U
	047GW00604	6/11/96	4.4 U	4.3 J	2.7 UJ
C047GW007	047GW00701b	6/14/95	1.9 U	3.2 U	4.5 U
	047GW00702	1/25/96	2.1 U	2.5 U	2.7 U
	047GW00703	5/14/96	13 UJ	2.5 UJ	3.9 J
	047GW00704	6/11/96	2.1 U	2.5 UJ	2.7 UJ
C047GW008	047GW00801c	6/15/95	1.9 U	3.2 U	4.5 U
	047GW00802	1/25/96	2.1 U	2.5 U	2.7 U
	047GW00803	5/15/96	13 UJ	2.5 UJ	3.4 U
	047GW00804	6/12/96	2.1 U	2.5 UJ	2.7 UJ

TABLE 4-1
SWMU 47 Groundwater Results for Arsenic, Antimony, and Thallium
CMS Work Plan, NFA, SWMU 47 in Zone C, Charleston Naval Complex

Station ID	Sample ID	Collection Date	Antimony Result/Qualifier ($\mu\text{g/L}$)	Arsenic Result/Qualifier ($\mu\text{g/L}$)	Thallium Result/Qualifier ($\mu\text{g/L}$)
C047GW009	047GW00901c	6/15/95	1.9 U	3.2 U	4.5 U
	047GW00902	1/26/96	2.1 U	2.5 U	4.6 U
	047GW00903	5/15/96	13 UJ	2.5 UJ	3.4 U
	047GW00904	6/12/96	3.9 U	2.5 UJ	2.7 UJ
C047GW010	047GW01001a	6/14/95	1.9 U	3.2 U	4.5 U
	047GW01002	1/25/96	2.1 U	2.5 U	2.7 U
	047GW01003	5/14/96	13 UJ	2.5 UJ	3.4 U
	047GW01004	6/12/96	2.2 U	2.5 UJ	2.7 UJ
C047GW011	047GW01101	6/15/95	1.9 U	46.3 =	4.5 U
	047GW01102	1/23/96	2.2 U	164 =	2.7 U
	047GW01103	5/14/96	13 UJ	159 =	3.4 U
	047GW01104	6/13/96	2.1 U	120 =	2.7 UJ
	047GW01106	7/23/99	5 U	22.3 =	2.3 U
	047GW011A6	7/23/99	5 U	4.2 J	2.3 U
	047GW011B6	7/23/99	5 U	3.4 J	2.3 U
	047GW011F5	1/19/99	2.7 U	28.2 =	3.1 U
C047GW012	047GW011U5	1/19/99	2.7 U	48.2 =	3.1 U
	047GW01201a	6/15/95	1.9 U	3.2 U	4.5 U
	047GW01202	1/23/96	2.1 U	15 =	5.8 U
	047GW01203	5/9/96	2.1 U	5.6 J	2.7 UJ
C047GW013	047GW01204	6/13/96	2.1 U	21.1 U	2.7 UJ
	047GW01301b	6/14/95	3.1 J	3.2 U	4.5 U
	047GW01302	1/24/96	2.1 U	2.5 U	3.4 U
	047GW01303	5/10/96	2.1 UJ	3.6 J	2.7 U
C047GW015	047GW01304	6/14/96	2.1 U	5.8 UJ	2.7 UJ
	047GW01501b	6/15/95	1.9 U	3.9 J	4.5 U
	047GW01502	1/25/96	2.1 U	6.5 J	2.7 U
	047GW01503	5/10/96	2.1 UJ	4.5 J	2.8 J
	047GW01504	6/14/96	2.1 U	6.1 UJ	2.7 UJ

Bold values are exceedances of MCLs (As = 50, Sb = 6, and Tl = 2 $\mu\text{g/L}$)

U Not detected; reported value is detection limit.
UJ Not detected; reported value is estimated detection limit.
J Detected; reported value is an estimated concentration.
= Detected; reported value equals detected concentration.

TABLE 4-2
 SWMU 47 Downgradient Monitor Well Results
 CMS Work Plan, NFA, SWMU 47 in Zone C, Charleston Naval Complex

Station ID	Sample ID	Collection Date	Chemical Name	Result/Qualifier ($\mu\text{g/L}$)
EGDEGW018	GDEGW01801	5/2/96	Arsenic	6.6 U
	GDEGW01802	7/30/96	Arsenic	9.3 J
	GDEGW01803	11/15/96	Arsenic	7.5 J
	GDEGW01804	1/29/97	Arsenic	7.4 J
EGDEGW18D	GDEGW18D01	5/2/96	Arsenic	2.5 U
	GDEGW18D02	7/30/96	Arsenic	2.5 U
	GDEGW18D03	11/15/96	Arsenic	2.5 UJ
	GDEGW18D04	1/29/97	Arsenic	2.5 U
EGDEGW027	GDEGW02701	10/31/96	Arsenic	23.3 =
	GDEGW027A2	3/4/97	Arsenic	7.5 J
	GDEGW027A3	6/24/97	Arsenic	2.1 U
	GDEGW02704	10/6/97	Arsenic	4.1 J
EGDEGW27D	GDEGW27D01	10/31/96	Arsenic	2.5 U
	GDEGW27DA2	3/4/97	Arsenic	2.1 U
	GDEGW27DA3	6/24/97	Arsenic	2.1 U
	GDEGW27D04	10/7/97	Arsenic	2.1 U
EGDEGW028	GDEGW02801	10/30/96	Arsenic	3.6 J
	GDEGW028A2	3/5/97	Arsenic	2.1 U
	GDEGW028A3	6/24/97	Arsenic	2.1 U
	GDEGW02804	10/7/97	Arsenic	2.1 U
EGDEGW28D	GDEGW28D01	10/30/96	Arsenic	7.1 J
	GDEGW28DA2	3/5/97	Arsenic	3.0 J
	GDEGW28DA3	6/25/97	Arsenic	6.4 J
	GDEGW28D04	10/7/97	Arsenic	3.9 J

U Not detected; reported value is detection limit.
 UJ Not detected; reported value is estimated detection limit.
 J Detected; reported value is an estimated concentration.
 = Detected; reported value equals detected concentration.

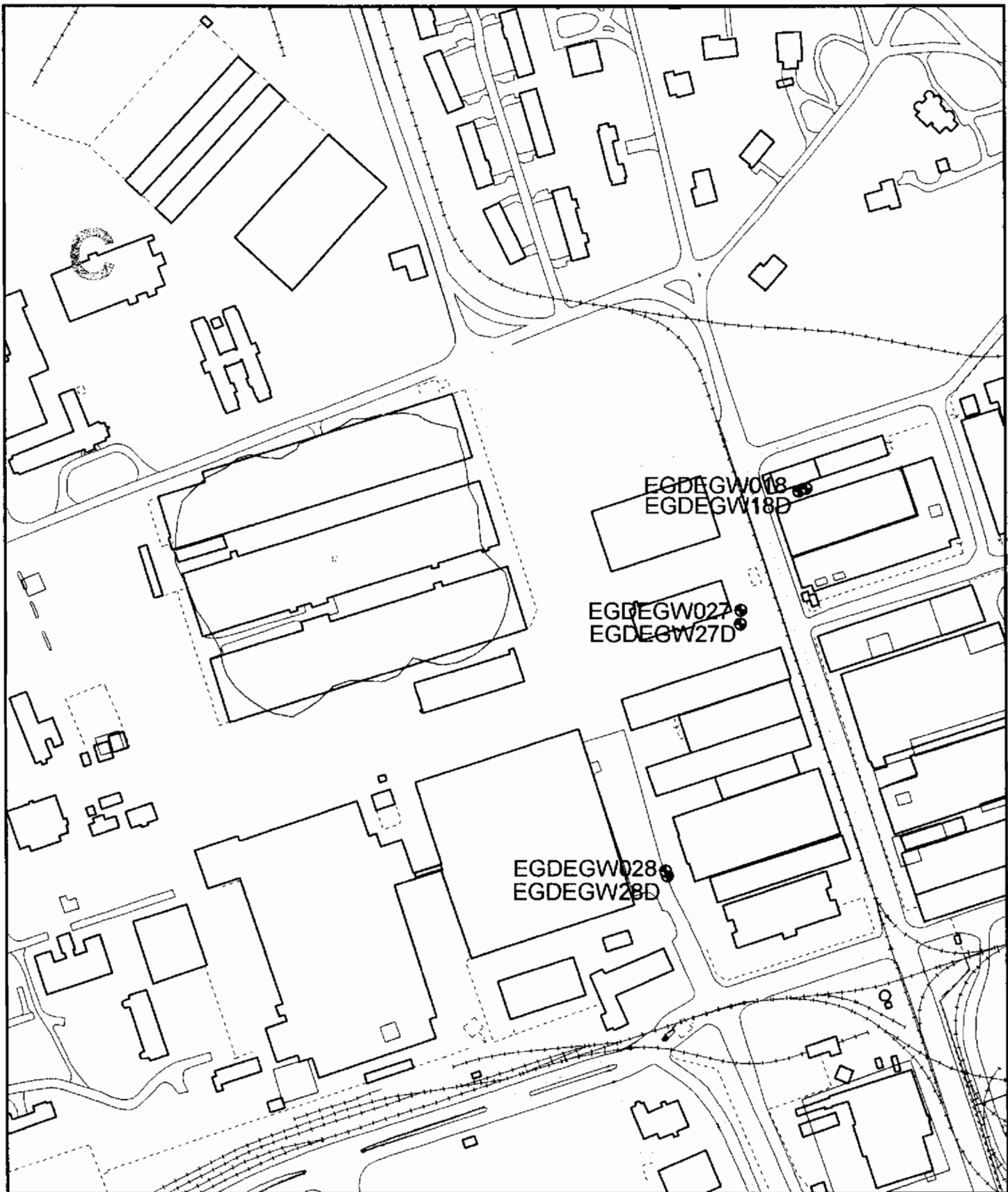


Figure 4-1
Downgradient Well Locations
SWMU 47, Zone C
Charleston Naval Complex

SECTION 5.0

Recommendations

5.0 Recommendations

SWMU 47, a former burning dump, was operated for approximately 5 to 6 years, between 1920 and 1926. No discernible contamination from the burning dump operations has been identified. No significant source areas of contamination have been found within the large area around SWMU 47 that has been investigated.

Following the removal of arsenic- and lead-contaminated soil in the vicinity of groundwater well C047GW007, and as proposed in the AOC 516 IM WP, further investigative or remedial work is not expected to be necessary at SWMU 47. The COCs identified in the RFI for surface soils will be less than their respective reference concentrations or below levels that could impact surficial groundwater.

Results of subsurface soil analyses were compared in the RFI to applicable screening criteria (EPA SSLs or background values). Analytes detected in subsurface soils were either not detected above their respective SSLs or not reliably identified in shallow groundwater, indicating that existing soil concentrations are protective of surficial groundwater (see page 10.2.28, Zone C RFI). No COCs for subsurface soil were identified.

Arsenic was identified as the sole COC in site groundwater. It was detected in three consecutive sampling efforts over a six-month period at a single location (C047GW011). The first sampling round at this location was below the MCL. Three subsequent sampling efforts between January and June 1996 reported arsenic concentrations approximately three times the MCL. After completion of the RFI, two additional sampling events were conducted in January and July of 1999. Five results were reported for these two sampling events, with no exceedances of the MCL for arsenic. The January 1999 sampling event reported filtered and unfiltered results of 28.2 and 48.2 $\mu\text{g/L}$, respectively, indicating that approximately 59 percent of the detected arsenic concentration was attributable to suspended solids in the sample. The July 1999 sampling event reported arsenic concentrations of 22.3, 4.2 J, and 3.4 J $\mu\text{g/L}$.

Recent data suggest that groundwater concentrations of arsenic are below applicable screening criteria (MCL). No potential source of arsenic has been identified near C047GW011, nor have hydraulically downgradient grid-based wells exhibited arsenic concentrations exceeding the MCL. The reason for the transient increase in arsenic concentrations at well C047GW011 is not known, but current data indicate that arsenic

- 1 concentrations are below the MCL. As such, further investigation of arsenic in groundwater
- 2 is not warranted.
- 3 Once the BCT concurs that NFA is appropriate for the site, a Statement of Basis will be
- 4 prepared that will be available for public comment in accordance with SCDHEC policy.
- 5 This will allow for public participation in the final remedy selection.

SECTION 6.0

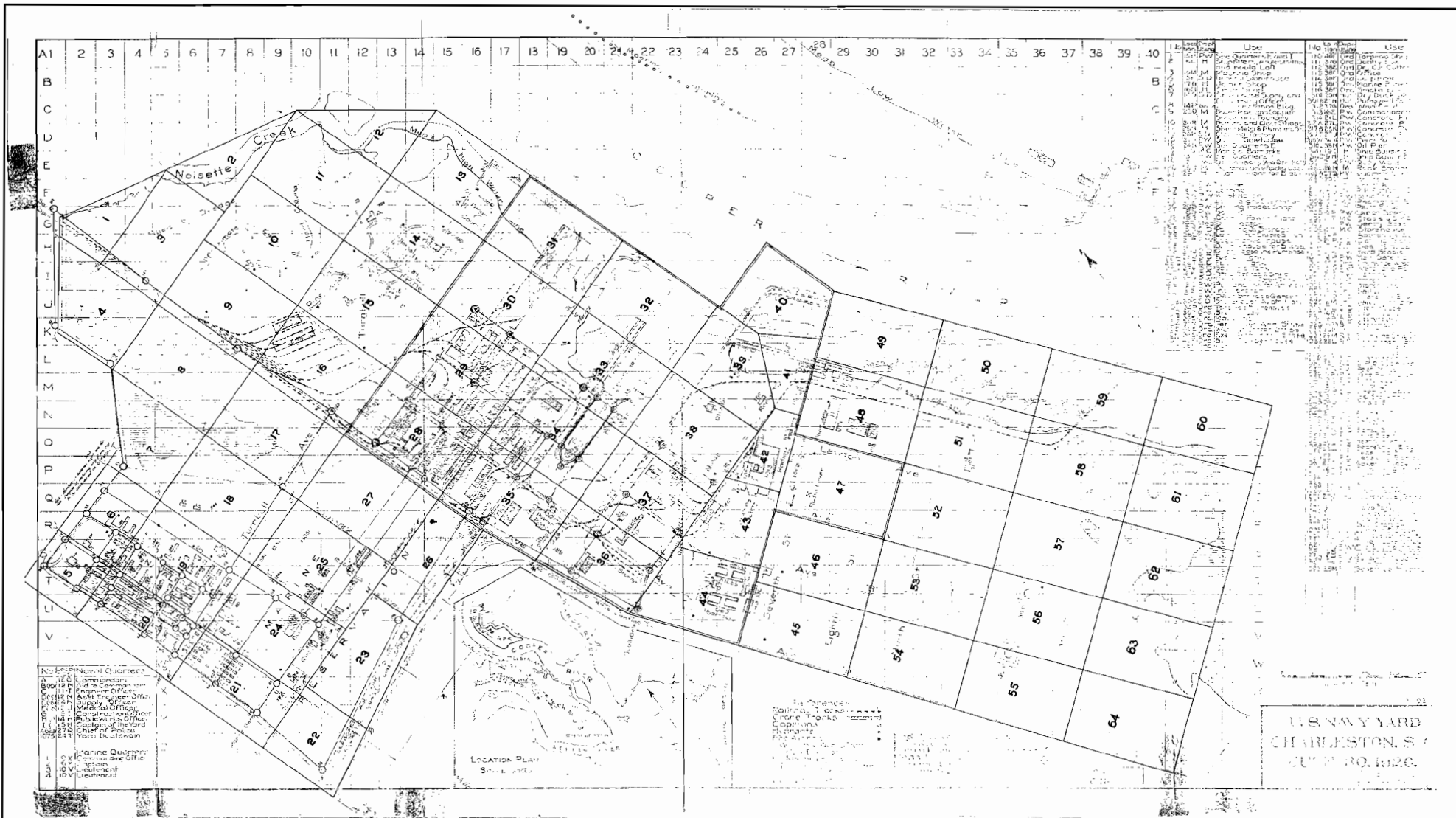
References

6.0 References

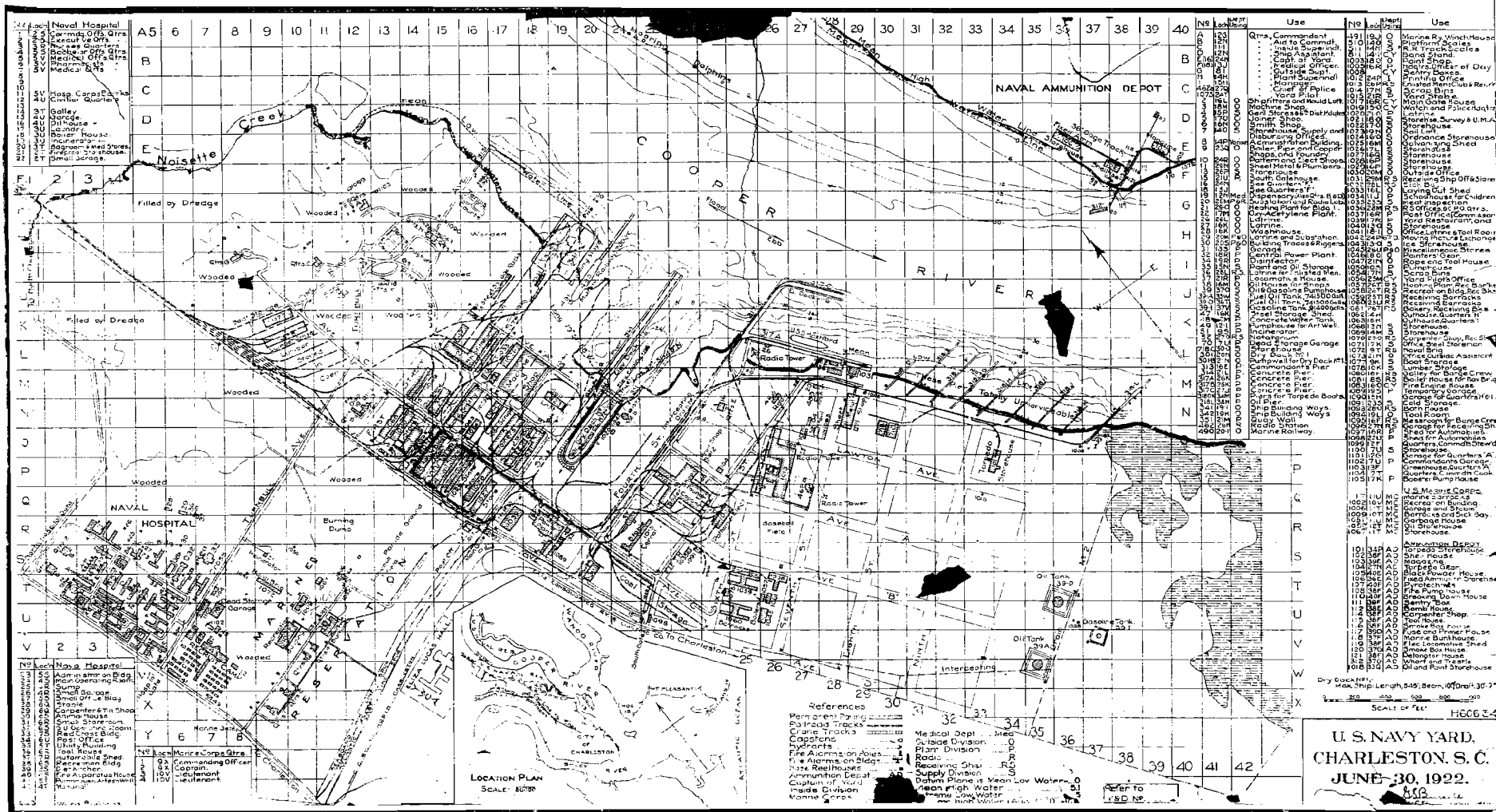
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APPENDIX A

Copies of Historic Engineering Drawings

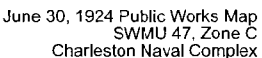


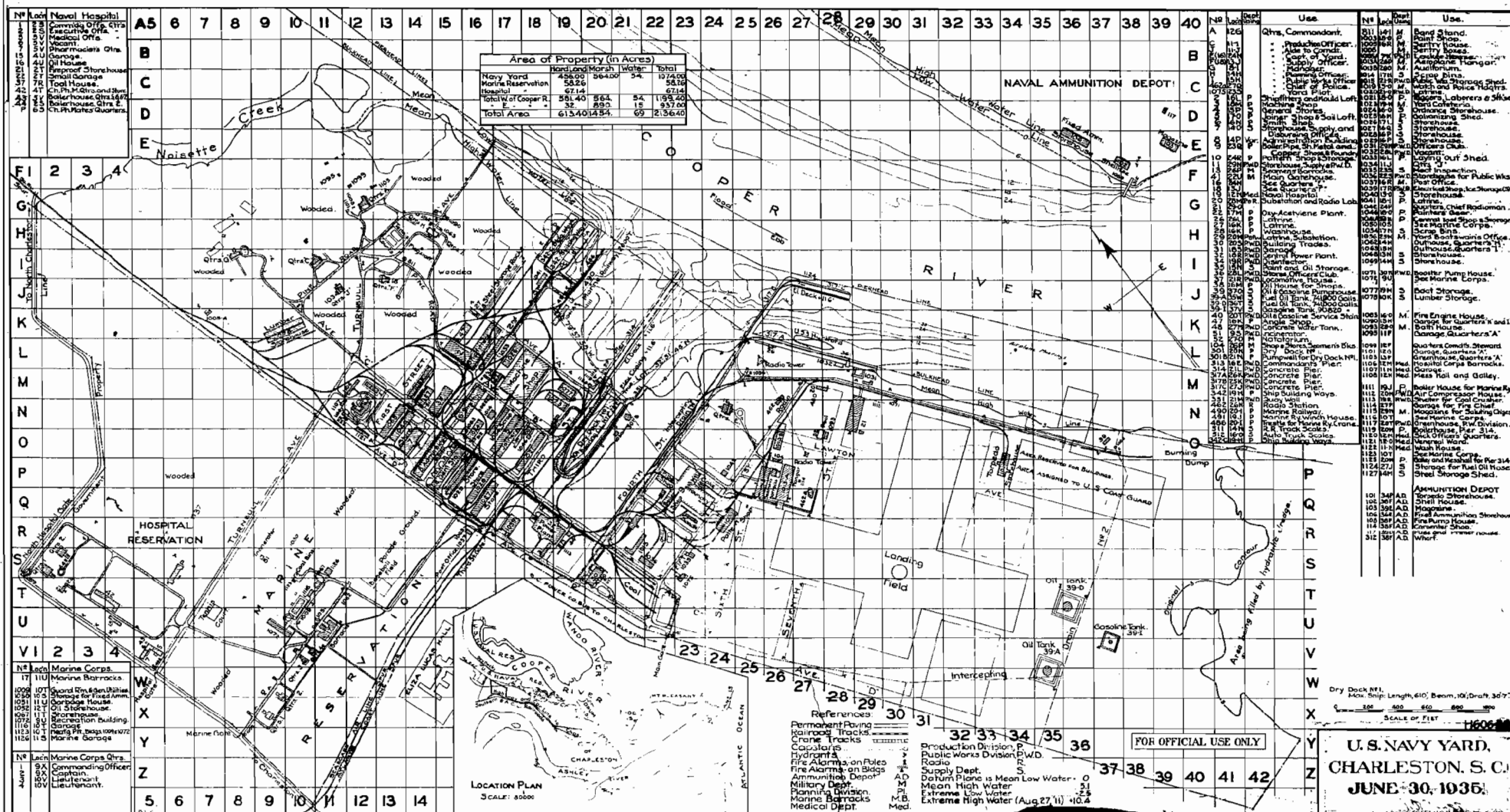
June 30, 1920 Public Works Map
SWMU 47, Zone C
Charleston Naval Complex



June 30, 1922 Public Works Map
SWMU 47, Zone C
Charleston Naval Complex

CH2MHILL





APPENDIX B

Excerpts from Zone C RFI

Table B-1. Surface soil BEQs in Zone C

STATION ID	SAMPLE ID	SAMPLE DATE	Value (µg/kg)
CGDCSB001	GDCSB00101a	03/15/95	348.0
CGDCSB002	GDCSB00201	03/13/95	713.3
CGDCSB003	GDCSB00301b	03/17/95	370.0
CGDCSB004	GDCSB00401a	04/14/95	719.3
CGDCSB005	GDCSB00501a	03/17/95	656.7
CGDCSB006	GDCSB00601b	03/17/95	749.5
CGDCSB007	GDCSB00701	04/14/95	701.6
CGDCSB008	GDCSB00801a	03/17/95	720.3
CGDCSB009	GDCSB00901	03/31/95	737.4
CGDCSB038	GDCSB03801a	06/29/95	713.8
CGDCSB039	GDCSB03901b	06/29/95	500.8
CGDCSB040	GDCSB04001b	06/29/95	425.0
Average =			613.0
Minimum =			348.0
Maximum =			749.5

BEQ value calculated using detection limit for PAHs with "J" or "=" qualifier

BEQ value calculated using 1/2 of the detection limit for PAHs with "U" or "UJ" qualifier

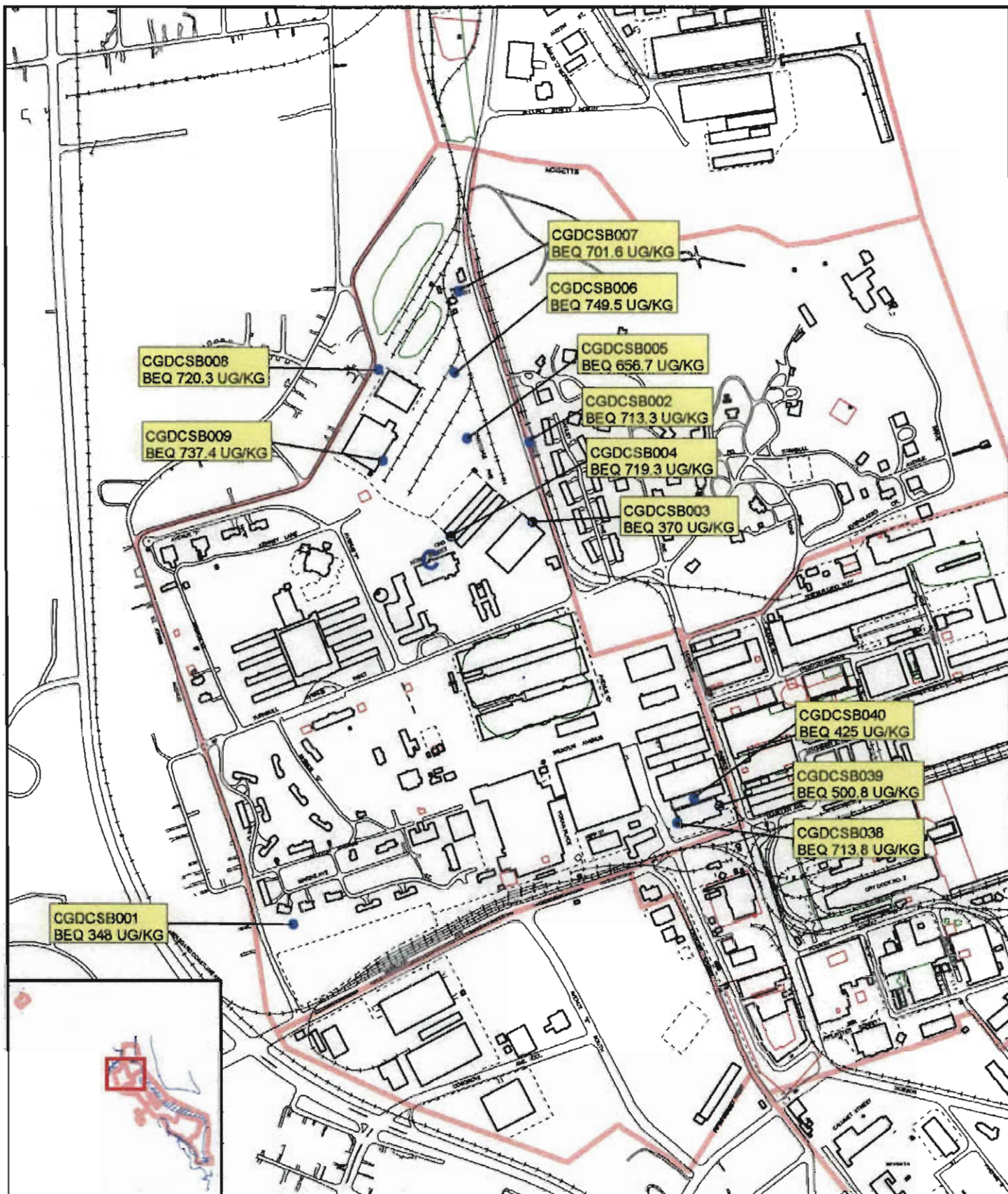


Figure B-1
BEQ Values at Grid-Based Sample Locations
Zone C
Charleston Naval Complex

- Zone c grid surface beq.dbf
- ▬ Fence
- ▬ Railroads
- ▬ Roads - Lines
- ▬ AOC Boundary
- ▬ SWMU Boundary
- ▬ Buildings
- ▬ Zone Boundary

0 500 1000 Feet

N

APPENDIX C

**Calculation of BEQ Reference
Concentration for Zone C**

10.2.2 Nature and Extent of Soil Contaminants

Soil analytical results for organics are in Table 10.2.3; results for inorganics are in Table 10.2.4. Appendix D is a complete analytical report for Zone C, and Appendix H contains detection only summary tables.

Table 10.2.3
 Organic Compound Analytical Results for Soil
 SWMU 47 — Former Burning Dump/AOC 516 — Wash Area/Battery Charging

Compound	Sample Interval	Frequency of Detection	Range of Detection	Mean	RBC ^a	Number of Samples Exceeding RBC
Volatile Organic Compounds (µg/kg) (Upper Interval — 16 Samples plus 2 Duplicates / Lower Interval — 13 Samples)						
Acetone	Upper	3/16	11.0 - 76.0	44.667	780,000	0
	Lower	4/13	11.0 - 24.0	17.0	800	0
Semivolatile Organic Compounds (µg/kg) (Upper Interval — 24 Samples plus 3 Duplicates / Lower Interval — 13 Samples)						
Acenaphthene	Upper	4/24	45.0 - 340.0	144.75	470,000	0
	Lower	2/13	310.0 - 430.0	370.0	20,000	0
Acenaphthylene	Upper	1/24	210.0	NA	4,700	0
Anthracene	Upper	8/24	47.0 - 1,100.0	255.50	2,300,000	0
	Lower	2/13	71.0 - 880.0	475.50	430,000	0
Benzo(a)anthracene	Upper	15/24	74.0 - 6,100	841.83	880 ^b	2
	Lower	3/13	250.0 - 1,600	900.0	700	2
Benzo(a)pyrene	Upper	14/24	72.0 - 4,600	799.71	88 ^b	12
	Lower	3/13	240.0 - 1,700	1,046.67	4,000	0
Benzo(b)fluoranthene	Upper	15/24	93.0 - 10,000	1,587.20	880 ^b	5
	Lower	3/13	430.0 - 1,700	1,243.33	4,000	0
Benzo(g,h,i)perylene	Upper	10/24	100.0 - 3,000	645.0	230,000	0
	Lower	3/13	150.0 - 600.0	440.0	98,000	0
Benzo(k)fluoranthene	Upper	15/24	100.0 - 11,000	1,721.33	8,800 ^b	1
	Lower	3/13	480.0 - 2,500	1,493.33	4,000	0

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Table 10.2.3
Organic Compound Analytical Results for Soil
SWMU 47 — Former Burning Dump/AOC 516 — Wash Area/Battery Charging

Compound	Sample Interval	Frequency of Detection	Range of Detection	Mean	RBC ^a	Number of Samples Exceeding RBC
Bis(2-ethylhexyl) phthalate	Upper	2/24	89.0 - 420.0	254.5	46,000	0
Chrysene	Upper	15/24	72.0 - 8,500	1,033.13	8,800 ^b	0
	Lower	3/13	380.0 - 1,300	960.0	1,000	2
1-Methylnaphthalene	Upper	3/24	50.0 - 130.0	81.33	310,000	0
	Lower	1/13	140.0	NA	3,000	0
2-Methylnaphthalene	Upper	3/24	42.0 - 100.0	62.0	310,000	0
	Lower	1/13	230.0	NA	3,000	0
Dibenzo(a,h)anthracene	Upper	4/24	65.0 - 1,000	419.25	88.0 ^b	2
	Lower	2/13	180.0 - 720.0	450.0	11,000	0
Dibenzo(a,j)acridine	Upper	2/24	100.0 - 190.0	145.0	31,000	0
Dibenzofuran	Upper	3/24	70.0 - 380.0	183.33	31,000	0
	Lower	2/13	69.0 - 200.0	134.5	12,000	0
Diethylphthalate	Upper	1/24	150.0	NA	6,300,000	0
Di-n-butylphthalate	Upper	2/24	86.0 - 135.0	110.5	780,000	0
	Lower	2/13	94.0 - 130.0	112.0	12,000	0
Fluoranthene	Upper	16/24	61.0 - 17,000	1,669.44	310,000	0
	Lower	3/13	390.0 - 2,800	1,263.33	98,000	0
Fluorene	Upper	4/24	58.0 - 650.0	243.0	310,000	0
	Lower	2/13	320.0 - 560.0	440.0	16,000	0
Indeno(1,2,3-cd)pyrene	Upper	10/24	110.0 - 3,200	656.00	880 ^b	2
	Lower	3/13	140.0 - 630.0	406.67	35,000	0
Naphthalene	Upper	2/24	150.0 - 430.0	290.0	310,000	0
	Lower	1/13	150.0	NA	3,000	0
Pentachlorophenol	Upper	1/24	660.0	NA	5,300	0
Phenanthrene	Upper	15/24	37.0 - 10,000	1,018.40	230,000	0
	Lower	3/13	320.0 - 3,300	1,426.67	98,000	0

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Table 10.2.3
Organic Compound Analytical Results for Soil
SWMU 47 — Former Burning Dump/AOC 516 — Wash Area/Battery Charging

Compound	Sample Interval	Frequency of Detection	Range of Detection	Mean	RBC ^a	Number of Samples Exceeding RBC
Phenol	Upper	1/24	68.0	NA	4,700,000	0
Pyrene	Upper	16/24	59.0 - 12,000	1,352.75	230,000	0
	Lower	4/13	48.0 - 1,900	697.0	140,000	0
BEQ	Upper	15/24	17.77 - 7,648.5	1,163.1	88	14
Pesticide and PCB Compounds (µg/kg) (Upper Interval — 16 Samples plus 2 Duplicates / Lower Interval — 13 Samples)						
Aldrin	Upper	2/16	0.14 - 0.31	0.225	38	0
	Lower	1/13	0.26	NA	5	0
alpha-BHC	Upper	2/16	0.13 - 0.51	0.32	100	0
beta-BHC	Upper	5/16	0.37 - 64.0	17.55	350	0
	Lower	2/13	18.0 - 40.0	29.0	2	2
4,4-DDD	Upper	3/16	0.40 - 8.20	5.43	2,700	0
	Lower	2/13	0.58 - 0.63	0.61	700	0
4,4-DDE	Upper	5/16	4.0 - 67.0	28.0	1,900	0
	Lower	1/13	1.3	NA	500	0
4,4-DDT	Upper	4/16	1.6 - 46.0	15.58	1,900	0
	Lower	2/13	0.43 - 0.56	0.495	1,000	0
delta-BHC	Upper	3/16	0.46 - 1.5	1.05	350	0
	Lower	1/13	0.32	NA	2	0
Dieldrin	Upper	1/16	1.6	NA	40	0
Endosulfan I	Upper	3/16	0.84 - 4.1	2.18	47,000	0
	Lower	2/13	1.5 - 1.7	1.6	300	0
Endosulfan II	Upper	2/16	0.28 - 3.6	1.94	47,000	0
	Lower	1/13	0.01	NA	300	0
Endosulfan sulfate	Upper	2/16	2.5 - 7.5	5.0	47,000	0
Endrin	Upper	1/16	0.64	NA	2,300	0
	Lower	2/13	0.34 - 0.52	0.43	400	0

Table 10.2.3
Organic Compound Analytical Results for Soil
SWMU 47 — Former Burning Dump/AOC 516 — Wash Area/Battery Charging

Compound	Sample Interval	Frequency of Detection	Range of Detection	Mean	RBC*	Number of Samples Exceeding RBC
Endrin aldehyde	Upper	4/16	0.34 - 8.80	3.04	2,300	0
	Lower	2/13	1.4 - 4.5	2.95	400	0
gamma-BHC	Upper	1/16	0.13	NA	490	0
Heptachlor	Upper	3/16	0.27 - 1.9	1.06	140	0
	Lower	1/13	9.3	NA	60	0
Heptachlor epoxide	Upper	5/16	0.17 - 5.5	1.73	70	0
	Lower	2/13	0.34 - 1.10	0.72	60	0
Methoxychlor	Upper	5/16	0.37 - 44.00	20.42	39,000	0
	Lower	2/13	3.7 - 30.0	16.85	62,000	0
Other Organic Compounds						
Total Petroleum Hydrocarbons (mg/kg) (Upper Interval — 16 Samples plus 2 Duplicates/Lower Interval — 13 Samples)						
Petroleum Hydrocarbons	Upper	16/16	17.8 - 2,050	316.36	100	9
	Lower	11/13	13.6 - 455	17.29	NA	0
Dioxins (ng/kg) (Upper Interval — 2 Duplicate Samples Only)						
1234678-HpCDD	2/2	Upper	4.898 - 21.729	13.31	NA	NA
1234678-HpCDF	2/2	Upper	89.4 - 112.325	100.86	NA	NA
123478-HxCDD	1/1	Upper	0.486	NA	NA	NA
123478-HxCDF	2/2	Upper	8.81 - 11.416	10.11	NA	NA
123678-HxCDD	1/1	Upper	0.663	NA	NA	NA
123678-HxCDF	2/2	Upper	2.493 - 5.784	4.14	NA	NA
123789-HxCDD	1/1	Upper	0.727	NA	NA	NA
123789-HxCDF	1/1	Upper	0.71	NA	NA	NA
234678-HxCDF	2/2	Upper	.711 - 1.687	1.199	NA	NA
OCDD	2/2	Upper	79.6 - 246.65	163.17	NA	NA

Table 10.2.3
Organic Compound Analytical Results for Soil
SWMU 47 — Former Burning Dump/AOC 516 — Wash Area/Battery Charging

Compound	Sample Interval	Frequency of Detection	Range of Detection	Mean	RBC*	Number of Samples Exceeding RBC
OCDF	2/2	Upper	22.1 - 291.7	256.9	NA	NA
TCDD TEQ	2/2	Upper	2.59 - 3.89	3.24	1,000	0

Notes:

* = Noncarcinogenic RBCs were adjusted to equate to a hazard quotient of 0.1.

† = These compounds are cPAHs and were multiplied by the appropriate BEF for comparison as BEQs.

All results are in micrograms per kilogram ($\mu\text{g/kg}$), except for Total Petroleum Hydrocarbons, which are in milligrams per kilogram (mg/kg) and dioxins which are in nanograms per kilogram (ng/kg).

Table 10.2.4
Inorganics Analytical Results for Soil
SWMU 47 — Former Burning Dump/AOC 516 — Wash Area/Battery Charging

Analyte	Sample Interval	Frequency of Detection	Range of Detection (mg/kg)	Mean (mg/kg)	Reference Conc.	Number of Samples Exceeding Reference
Aluminum	Upper	16/16	3,045 - 13,900	6,413.10	9,990	2
	Lower	13/13	1,030 - 22,300	6,268.46	23,700	0
Antimony	Upper	4/16	0.40 - 1.90	1.02	0.55	2
	Lower	6/13	0.22 - 1.40	0.73	0.92	1
Arsenic	Upper	9/16	0.38 - 27.8	6.16	14.2	1
	Lower	7/13	0.47 - 12.2	4.37	14.1	0
Barium	Upper	16/16	7.4 - 170.0	32.69	77.2	1
	Lower	13/13	5.2 - 273.0	44.35	68.5	2
Beryllium	Upper	3/16	0.37 - 0.50	0.42	ND	3
	Lower	2/13	0.62 - 1.10	0.86	0.98	1
Cadmium	Upper	1/16	2.9	NA	0.65	1
	Lower	1/13	2.8	NA	0.28	1
Calcium	Upper	16/16	298 - 63,100	12,152.81	NA	0
	Lower	13/13	115 - 61,800	9,262.85	NA	0
Chromium	Upper	16/16	2.8 - 44.6	14.30	26.4	3
	Lower	13/13	1.2 - 37.7	11.74	12.5	5

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Table 10.2.4
Inorganics Analytical Results for Soil
SWMU 47 — Former Burning Dump/AOC 516 — Wash Area/Battery Charging

Analyte	Sample Interval	Frequency of Detection	Range of Detection (mg/kg)	Mean (mg/kg)	Reference Conc.	Number of Samples Exceeding Reference
Cobalt	Upper	13/16	0.57 - 9.70	2.97	3.22	4
	Lower	11/13	0.13 - 7.20	2.03	7.1	1
Copper	Upper	16/16	1.3 - 416.0	43.38	34.7	3
	Lower	12/13	0.9 - 1,650	178.38	42.2	2
Iron	Upper	16/16	924 - 63,900	8,115.88	NA	0
	Lower	13/13	678 - 45,200	8,434.46	NA	0
Lead	Upper	16/16	3.3 - 1,120	112.07	330	1
	Lower	13/13	2.1 - 1,190	124.91	73.2	2
Magnesium	Upper	16/16	134.0 - 3,650	813.03	NA	0
	Lower	13/13	41.1 - 4,630	1,027.47	NA	0
Manganese	Upper	16/16	5.3 - 331.0	55.08	92.5	2
	Lower	13/13	3.1 - 276.0	62.38	106	2
Mercury	Upper	5/16	0.13 - 2.20	0.60	0.24	2
	Lower	3/13	0.52 - 8.2	3.11	0.30	3
Nickel	Upper	16/16	0.73 - 26.50	6.36	12.3	2
	Lower	13/13	0.38 - 60.70	8.90	16.7	1
Potassium	Upper	15/16	81.3 - 1,010	348.63	NA	0
	Lower	12/13	85.8 - 2,120	452.01	NA	0
Selenium	Upper	9/16	0.47 - 2.40	0.96	1.44	2
	Lower	7/13	0.58 - 2.50	1.39	2.90	0
Sodium	Upper	5/16	295.5 - 1,000	638.70	NA	0
	Lower	4/13	283.0 - 1,020	546.25	NA	0
Thallium	Upper	1/16	2.1	N	ND	1
	Lower	~1/13	1.8	NA	ND	1
Tin	Upper	11/16	0.94 - 46.70	9.25	2.95	4
	Lower	11/13	0.67 - 365.0	39.22	2.37	2

Table 10.2.4
Inorganics Analytical Results for Soil
SWMU 47 — Former Burning Dump/AOC 516 — Wash Area/Battery Charging

Analyte	Sample Interval	Frequency of Detection	Range of Detection (mg/kg)	Mean (mg/kg)	Reference Conc.	Number of Samples Exceeding Reference
Vanadium	Upper	16/16	1.7 - 44.1	11.67	23.4	2
	Lower	13/13	1.1 - 78.8	17.29	56.9	2
Zinc	Upper	16/16	5.2 - 1,100	140.61	159	3
	Lower	13/13	2.5 - 1,320	141.41	243	1

Volatile Organic Compounds in Soil

Acetone was the only VOC detected in soil samples. It was detected at three locations in the upper interval and at four locations in the lower interval. Acetone did not exceed its RBC at any location.

Semivolatile Organic Compounds in Soil

Twenty-five SVOCs were detected at SWMU 47/AOC 516. Six compounds exceeded RBCs in the upper interval; all of the SVOCs that exceeded their RBCs are cPAHs. Two compounds exceeded their SSLs in the lower interval. The BEQ calculated exceeded the RBC of 88.0 $\mu\text{g/kg}$ for BaP at 14 locations in the upper interval. The highest BEQs were at locations 047SB005 (upper) and 047SB016 (upper). Second-round analytical results indicated that SVOCs were present at additional sampling sites 047SB016, 047SB017, 047SB018, and 047SB019 (Figure 10.2.1).

Pesticides and PCBs in Soil

Seventeen pesticides were detected in the upper sample interval from 12 sample locations; 13 pesticides were detected in the lower interval from four locations. However, no pesticide

AOC 516 was used for spray washing vehicles and more recently was used for recharging lead-acid batteries. Building 233 is located on this site. These two sites are combined for the evaluation of fate and transport based on their proximity. Environmental media sampled as part of the SWMU 47 investigation include surface soil, subsurface soil, and groundwater. Potential migration pathways for SWMU 47 include constituents leaching from soil to groundwater, groundwater migration to surface water, and emission of volatile constituents from surface soil to air.

10.2.5.1 Soil to Groundwater Cross Media Transport

Table 10.2.8 compares the maximum detected concentrations of chemicals in soil to the greater of the groundwater protection SSLs or background reference concentrations. Five organic compounds (benzo(a)anthracene, benzo(f)fluoranthene, alpha-BHC, beta-BHC, and pentachlorophenol) and five inorganic chemicals (chromium, cobalt, copper, mercury, and tin) were detected above SSLs in soil but were not found above reference or risk-based concentrations in shallow groundwater in first-quarter samples. A review of subsequent quarterly results confirmed their absence at significant levels. As a result, existing soil concentrations are considered protective of the water table aquifer.

Lead was detected above reference concentrations exclusively in boring 047SB007. The closest monitoring well, 047007, produced samples with nondetect lead for four consecutive quarters. Monitoring well 047001 produced an exceedingly high lead result first quarter (467 µg/L). Subsequent quarterly results were nondetect indicating the initial data gave an erroneous account of groundwater quality. A single exceedance of the lead TTAL (15 µg/L) was noted in the second quarter samples from 047010, but following quarterly results were below the groundwater standard.

Hypothetical Site Residents

For the ingestion pathway, the lifetime weighted average ILCR was computed to be 1E-3. 3,3'-Dimethylbenzidine and arsenic are the sole contributors. HQ for the adult and child resident are 4 and 10 for the ingestion pathway. Arsenic was the sole contributor for both receptor groups.

Hypothetical Site Workers

For the ingestion pathway, the ILCR was computed to be 3E-4. Arsenic was the sole contributor. The ingestion pathway HI was computed to be 2 based on arsenic.

Current Site Workers

Shallow groundwater is not currently used as a potable water source for SWMU 47, or other areas of Zone C. In the absence of a completed exposure pathway, no threat to human health is posed by reported shallow groundwater contamination.

Lead Toxicity — Groundwater

As discussed in Section 10.2.6.2, first round groundwater results suggested gross contamination of the shallow aquifer. The results of subsequent sampling, however, led to the conclusion that first quarter results were anomalous and not representative of true aquifer quality. In fact, the four-quarter mean lead concentration in each well was found to be less than the 15 µg/L TTAL. As a result, existing lead levels are considered protective of human health and no formal analysis was warranted.

COCs Identified

COCs were identified based on cumulative (all pathway) risk and hazard projected for this site. USEPA has established a generally acceptable risk range of 1E-4 to 1E-6, and a HI threshold of 1.0 (unity). In this HHRA, a COC was considered to be any chemical contributing to a cumulative risk level of 1E-6 or greater and/or a cumulative HI above 1.0, and whose individual

ILCR exceeds 1E-6 or whose HQ exceeds 0.1. For carcinogens, this approach is relatively conservative, because a cumulative risk level of 1E-4 (and individual ILCR of 1E-6) is recommended by USEPA Region IV as the trigger for establishing COCs. The COC selection method presented was used to provide a more comprehensive evaluation of chemicals contributing to carcinogenic risk or noncarcinogenic hazard during the remedial goal options development process. Table 10.2.24 summarizes of COCs identified in each medium based on contribution to cumulative ILCR or HI.

Surface Soils

Hypothetical Site Residents (Future Land Use)

BEQs, arsenic, beryllium, and thallium were identified as COCs based on their contribution to cumulative ILCR and/or hazard. BEQs and arsenic in surface soil are shown on Figures 10:2.4 and 10.2.5.

Hypothetical Site Workers (Current Land Use)

BEQs and arsenic were identified as COCs based on their contribution to cumulative ILCR and/or hazard.

Aluminum and arsenic were detected in soil throughout SWMU 47. The mean concentrations for these elements were, however, less than their respective background reference concentrations. Beryllium was detected in three of 16 surface soil samples with a maximum concentration of 0.5 mg/kg. The calculated beryllium UCL (0.267 mg/kg) is comparable to the four beryllium detections reported at Zone C background locations. Thallium was detected at only one surface soil sampling location at a concentration of 2.1 mg/kg. Its absence at other locations indicates that the potential for chronic exposure is low.

The highest BEQ concentrations were reported at locations 047SB005 (7.648 mg/kg) and 047SB016 (4.373 mg/kg). Both samples were collected from small patches of grass-covered soil amidst buildings and roadways near Buildings NSC-64, NSC-66, and NSC-67. BEQ concentrations in excess of 0.5 mg/kg were reported throughout the SWMU 47 area. As a result, chronic exposure to BEQs at concentrations above residential and industrial RBCs is possible for individuals working or residing in this area.

Groundwater

Hypothetical Site Residents (Future Land Use)

Arsenic was identified as the only COC for this scenario based on the sum ILCR and HI. Arsenic concentrations in Zone C shallow groundwater are shown on Figure 10.1.7.

Hypothetical Site Workers (Current Land Use)

Arsenic was identified as the only COC for this scenario based on the sum ILCR and HI.

Due to the limited extent of identified shallow groundwater impacts, graphical presentation of risk projections for SWMU 47 shallow groundwater would be of limited use. Alternatively, the extent of each COC is briefly discussed below. Arsenic concentrations were generally consistent throughout SWMU 47, with the sample from well 047011 (46.3 µg/L) having the only concentration above 9.2 µg/L. Although former site operations (lead-acid batter recharging) could be a potential source of heavy metals, monitoring well 047007 did not have significantly elevated arsenic concentrations. It is possible that reported shallow groundwater concentrations in the two principal metals-impacted wells could be associated with entrained sediment. Subsequent quarterly sampling results corroborated the relatively dramatic arsenic impacts in well 047011.

APPENDIX D

Soil Boring Logs

EnSafe/Allen & Hoshall

Monitoring Well NBCC047001

Project: Zone C - Naval Base Charleston

Coordinates: 2315367.46 E, 376790.03 N

Location: Charleston, SC

Surface Elevation: 8.3 feet msl

Started at 0755 on 4-11-95

TOC Elevation: 8.35 feet msl

Completed at 0840 on 4-11-95

Depth to Groundwater: 4.17 feet TOC Measured: 6-21-95

Drilling Method: 4.25" ID (7.5" OD) HSA with split spoon

Groundwater Elevation: 4.18 feet msl

Drilling Company: Alliance Environmental

Total Well Depth: 12.9 feet bgs

Geologist: Peter Bayley

Well Screen: 2.9 to 12.9 feet bgs

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)	WELL DIAGRAM
								Surface conditions: Asphalt		
5			1	100	0		SP SM	Sand: brown-black, very fine to fine, some silt, moist to wet, soft.	5.3	
10			2	15	0		SP	6" piece of wood in split spoon with brown, very fine to fine sand soft, wet.	3.3	
15			3	33	0		SP	4" Wood debris, with brown, very fine to fine, sand, soft, wet.	4.7	
20										

EnSafe/Allen & Hoshall

Monitoring Well NBCC047008

Project: Zone C - Naval Base Charleston

Coordinates: 2315247.58 E, 376855.51 N

Location: Charleston, SC

Surface Elevation: 8.4 feet msl

Started at 0830 on 4-12-95

TOC Elevation: 9.16 feet msl

Completed at 0930 on 4-12-95

Depth to Groundwater: 4.58 feet TOC Measured: 6-21-95

Drilling Method: 4.25" ID (7.5" OD) HSA with split spoon

Groundwater Elevation: 4.58 feet msl

Drilling Company: Alliance Environmental

Total Well Depth: 26 feet bgs

Geologist: Peter Bayley

Well Screen: 2.6 to 12.6 feet bgs

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PTD (bpm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)	WELL DIAGRAM
5			1	71	0.4			Auger cuttings from 0-2.5': Sand: black to brown, very fine to fine, dry wood at 2' bgs, gray, silty, moderately plastic clay from 2-2.5'.		<p>PVC Riser</p> <p>2" ID Sch. 40 PVC, 0.01 slot screen</p> <p>10-20 sand filler</p> <p>bentonite seal</p> <p>end cap</p>
							CH	Clay: gray with a 1" yellow basal silt layer, some silt, firm, plastic, wet.	6.4	
							SP	Sand: dark brown, very fine to fine, some silt, trace of clay, soft, moist.	5.7	
							SM		5	
10			2	50	0.4			Sand: brown, very fine to fine, trace of silt, soft, wet.	14	
							SP		9	<p>PVC Riser</p> <p>2" ID Sch. 40 PVC, 0.01 slot screen</p> <p>10-20 sand filler</p> <p>bentonite seal</p> <p>end cap</p>
							CH	Clay: olive-gray with streaks of yellow marl, some silt, firm, plastic, moist to wet.	9	
							SP	Sand: dark brown, very fine to fine, some silt, trace clay, soft, wet. soft.	8.6	
									8	
15			3	100	0.9			Sand: brown, very fine to fine, trace of silt, soft, wet, interbedded with 3" dark gray, silty clay, some sand, plastic, wet.	3.8	
							SP		5.6	
20										

APPENDIX E

SCDHEC Responses to Comments

**Response to Comments from
Susan Peterson (SCDHEC) on the
CMS Work Plan for SWMU 47, Zone C
Rationale for No Further Action,
Revision 0, December 2000**

Comments

1. Clarifications

The Department spoke with Dean Williamson of CH2M-Jones on February 23, 2001. The following issues were clarified to the Department's satisfaction:

- a) The status of the IM at 516. CH2M-Jones has completed confirmatory sampling and will begin the proposed soil excavation shortly.
- b) The number of samples collected at SWMU 47. CH2M-Jones will revise Section 2.0 to give a more accurate assessment of the number of media samples collected.
- c) The "reference concentration" terminology.

The Department has enclosed a copy of the February 23, 2001 Memorandum that details the above clarifications as part of this submittal.

Response: Comment noted. The soil excavation at AOC 516 has been successfully completed as of March 12, 2001.

2. Description of burning dump location

As stated by the Navy in Section 3.1, the actual diameter of the burning dump is not known. Only the approximate footprint area of the former burning dump can be projected. DHEC concurs with those statements. DHEC recommends either omitting the word "actual" or substituting the word "presumed" for "actual" in Section 3.1.1 where the Navy states "Within the actual area of the burning dump." Please revise other sections as needed.

Response: The word "actual" will be deleted where it references the location of the burning dump as determined by CH2M-Jones' review of historic engineering drawings. The word "presumed" will be used to replace "actual" where appropriate.

3. Revision of text in Sections 4.3 and 4.5

On lines 7-9 of Section 4.3, CH2M-Jones states "because the most recent data suggest that there are no contaminants currently present above their respective MCLs in site groundwater, there is no excessively contaminated groundwater plume to migrate to a storm sewer." Please revise this sentence by deleting the word "excessively."

On lines 31-2 of Section 4.5, CH2M-Jones states "Due to the fact that significant source area contamination was not identified at SWMU 47, and that the nearest water-receiving body is 1,700 feet to the north-northwest, indicates that surface water runoff from SWMU 47 would not be an ecological concern at Noisette Creek." Please revise this sentence by deleting the word "significant."

Response: The words "excessively" and "significant" will be deleted where indicated.

4. Table 4-1

There appears to be an error in the reporting of the units for Table 4-1. Please revise the table to report the groundwater results in ug/L, rather than mg/kg.

Response: Table 4-1 will be revised to read µg/L rather than mg/kg.

**Response to Comments from
Mansour Malik (SCDHEC) on the
CMS Work Plan for SWMU 47, Zone C
Rationale for No Further Action,
Revision 0, December 2000**

Comments:

1. Section 3.1.1 BEQs (Page 3-4), Lines 4-5: "The proposed Zone C reference....". This statement should be reviewed in the light of the latest basewide and railroad BEQs background value to be developed and agreed upon by the BCT task team. Additional assessment at C047SB017 might be necessary.

Response: Section 3.1.1, BEQs will be modified. Below is the proposed replacement for the BEQ discussion.

"Polynuclear aromatic hydrocarbons (PAHs), expressed as BEQs, were identified as a COC in the RFI report prepared by EnSafe at the combined AOC 516/SWMU 47, based on exceedances of the RBC of 88 micrograms per kilogram ($\mu\text{g}/\text{kg}$). PAHs are routinely detected in non-impacted as well as impacted areas of the CNC. The detected PAHs, and resulting calculated BEQs, in the non-impacted areas (grid-based samples) of CNC were used to calculate a BEQ value to be used as a base-wide reference concentration. The data, and analysis, was presented in the Background PAHs Study Report - Technical Information for Development of Background BEQ Values, Rev 0, February 2001 presented to the BCT. The BEQ reference concentration is 1,304 $\mu\text{g}/\text{kg}$ for surface soil.

Comparison of calculated BEQ values from SWMU 47 to the CNC reference concentration resulted in two BEQ exceedances out of 64 samples (3.1 percent) collected and analyzed for PAHs at SWMU 47. Both exceedances are located near the northeast corner of the site, as indicated in the RFI (EnSafe, 1997). C047SB005 (7,648.5 $\mu\text{g}/\text{kg}$) is located next to Turnbull Avenue West, and C047SB016 (5,169.6 $\mu\text{g}/\text{kg}$) is located across Avenue D. These two sample locations are remote from the location of the burning dump, as discussed in Section 2.0, and are not likely related to burning dump operations.

It can also be seen in Figures 2-1 through 2-4 that railroad tracks were located along Avenue D very close to sample location C047SB016. Railroad tracks can be seen on the earliest available engineering drawing (June 1920, Figure 2-1). After the construction of Buildings 64, 66, and 67, sometime between June 1935 and June 1942, rail service was connected to these buildings. The railroad is seen in the July 1970 (Figure 2-4) engineering drawing, but not in the October 1977 (Figure 2-5) engineering drawing, indicating that the railroad tracks were removed between July 1970 and

October 1977 and the railroad tracks were present in this area for at least 50 years. Creosote (railroad ties), petroleum products, and train engine emissions and leaks of engine oil from railroad operations are all sources of PAHs.

Both sampling locations are located between asphalt roads and asphalt parking areas; and the site is located within a high traffic, industrial area of the base, with extensive asphalt paved areas. Pavement, motor vehicle emissions, and petroleum products are all sources of PAHs. Thus it is most likely that activities not related to operations associated with the burning dump or SWMU 47 contributed to the PAHs at these sampling locations.

The mean BEQ concentration within the site, as described in the RFI (1203.2 micrograms per liter [$\mu\text{g/kg}$]), is below the reference concentration.

Within the area of the burning dump, reported BEQ values are all below the CNC reference concentration. Based on the above information, further evaluation, or remediation, of BEQs is not warranted at SWMU 47."

2. Section 3.1.2 Subsurface Soil, Lines 1-3: The text refers to Fig 2.2 as illustrating the locations of soil samples analyzed as part of "this IM WP". The Fig 2.2 represents base conditions in 1924 and 1926 and the text seems to be referencing the IM WP for AOC 516. Please clarify and amend the statement as intended.

Response: The first paragraph of Section 3.1.2 should have referred to figure 3-1 and "this CMS WP". Below is the revised paragraph that will be included in the revised report.

"Subsurface soil samples were collected as part of the RFI at each of the soil boring locations. Figure 3-1 illustrates the locations of the soil samples analyzed as part of this CMS WP.

3. Appendix A: When presenting historical maps and figures in a document, the relevant SWMU/AOC boundaries should also be represented (highlighted). Including this information in all future documents will facilitate and expedite the review process.

Section 3.1.3 Groundwater, (page 3-5), Line 30+: the text referenced location C047GW011. This location is not shown on figure 3-2 provided in the section. Please include.

Response: Historical drawings are not typically in a format that lends themselves to simple electronic manipulation. However, CH2M-Jones

will attempt to provide the approximate SWMU/AOC boundaries on these figures in the future. This may result in figure annotations being made by hand.

Monitor well C047GW011 was inadvertently omitted from Figure 3-2. It will be added to the figure.